United States Court of Appeals
for the
District of Columbia Circuit

TRANSCRIPT OF RECORD

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United States Court of Appeals for the District of Columbia

APRIL TERM, 1936.

No. 6753

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RAYTHEON MANUFACTURING COMPANY, OF NEWTON, MASSACHUSETTS, AND CHARLES G. SMITH, OF MEDFORD, MASSACHUSETTS, APPELLANTS,

vs.

CONWAY P. COE, COMMISSIONER OF PATENTS.

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF COLUMBIA.

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United States Court of Appeals for the District of Columbia

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PRESS OF BYRON S. ADAMS, WASHINGTON, D. C.

United States Court of Appeals for the District of Columbia

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a Supreme Court of the District of Columbia

IN EQUITY No. 58006

RAYTHEON MANUFACTURING COMPANY, of Newton, Massachusetts, and CHARLES G. SMITH, of Medford, Massachusetts, *Plaintiffs,*

vs.

CONWAY P. COE, Commissioner of Patents, *Defendant.*

UNITED STATES OF AMERICA,
District of Columbia, ss:

BE IT REMEMBERED, That in the Supreme Court of the District of Columbia, at the City of Washington, in said District, at the times hereinafter mentioned, the following papers were filed and proceedings had, in the above-entitled cause, to wit:—

1 Filed November 30 1934

In the Supreme Court of the District of Columbia

Holding and Equity Court

IN EQUITY No. 58006

RAYTHEON MANUFACTURING COMPANY, of Newton, Massachusetts, and CHARLES G. SMITH, of Medford, Massachusetts, *Plaintiffs,*

vs.

CONWAY P. COE, Commissioner of Patents, *Defendant.*

Bill of Complaint to Issue Patent

Plaintiffs for their bill of complaint say that they are informed and believe and therefore aver as follows:

1. The plaintiff, Raytheon Manufacturing Company, is a corporation organized and existing under the laws of the State of Delaware, and a citizen of the United States, hav-

ing a regular and established place of business at Newton, in the Commonwealth of Massachusetts. The plaintiff, Charles G. Smith, is a citizen of the Commonwealth of Massachusetts and of the United States, residing at Medford, in said Commonwealth of Massachusetts. The defendant, Conway P. Coe, is the Commissioner of Patents of the United States, a resident of Washington, in the District of Columbia.

2. This is a suit arising under the patent laws of the United States and specifically under Section 4915 of the Revised Statutes.

3. The plaintiff, Charles G. Smith, was the original, first and sole inventor of certain new and useful improvements in Electric Devices not known or used before his invention or discovery thereof and not patented or described in any printed publication in any country before his invention or discovery thereof and not patented or described in any printed publication or in public use or on sale in the United States more than two years prior to the filing of his 2 original application for patent hereinafter referred to, and not abandoned. No application for patent on said improvements was filed by him or his legal representatives or assigns, nor was any patent thereon granted to him or his legal representatives or assigns in any country foreign to the United States prior to the filing of his said original application for United States patent hereinafter referred to.

4. The plaintiff, Charles G. Smith, being entitled to Letters Patent of the United States for said improvements under the provisions of the statutes of the United States, filed an original application in due and proper form to Thomas E. Robertson, legal predecessor of the defendant, as Commissioner of Patents of the United States, for Letters Patent for said improvements on March 5, 1925, said application bearing Serial No. 13,146. Thereafter from time to time certain amendments in the specification and claims of said application were duly made, as will more fully and at large appear from a duly certified copy of the proceedings in the Patent Office on said application, ready in court to be produced.

5. On July 27, 1932 the Primary Examiner allowed said original application as then amended. The plaintiffs herein

failed to make payment of the final fee on said original application within the time allowed by law. On June 22, 1933, under the provisions of the statutes of the United States, the plaintiff, Charles G. Smith, filed a renewal application in due and proper form to said Thomas E. Robertson, legal predecessor of the defendant, as Commissioner of Patents of the United States, and prayed that the original specification, oath and drawing of said original application, Serial No. 13,146, might be used as a part of said renewal application. Upon the filing of said renewal application, certain amendments to the claims of said application were duly made, as will more fully and at large appear from said duly certified copy of the proceedings in the Patent Office on said original application mentioned
3 above, which certified copy will also include the proceedings in said Patent Office on said renewal application. A copy of said renewal application as finally amended is hereto attached and marked Exhibit A.

6. The plaintiff, Charles G. Smith, duly assigned to the American Appliance Company, a corporation duly organized and existing under the laws of the Commonwealth of Massachusetts, the entire right, title and interest in and to said original application and in and to any Letters Patent to be granted thereon, and requested Thomas E. Robertson, legal predecessor of the defendant as Commissioner of Patents, to issue said Letters Patent to said American Appliance Company as assignee by an instrument in writing dated August 22, 1925, duly recorded in the United States Patent Office. Said American Appliance Company later changed its name to Raytheon Manufacturing Company in accordance with a document in writing duly recorded in the United States Patent Office on November 5, 1925. Said Raytheon Manufacturing Company later changed its name to Raytheon, Inc. in accordance with a document in writing duly recorded in the United States Patent Office on June 29, 1928. Said Raytheon, Inc. later assigned to the plaintiff, Raytheon Manufacturing Company, the entire right, title and interest in and to said original application and in and to any Letters Patent to be granted thereon, and requested Thomas E. Robertson, legal predecessor of the defendant as Commissioner of Patents, to issue said Letters Patent to said Raytheon Manufacturing Company as as-

signee by an instrument in writing dated June 28, 1933, and duly recorded in the United States Patent Office. All of the above will more fully appear from said various assignments and documents, or legally authenticated copies thereof, ready in court to be produced. The plaintiff, Raytheon Manufacturing Company has been since the date of said last assignment, and now is, vested with the entire right,
title and interest in and to said applications and in
4 and to any Letters Patent to be granted thereon.

7. On July 13, 1933 the Primary Examiner duly allowed claims 8, 22, 23, 28, 30, 31, 32, 33 and 38, but rejected claim 40, specifying that it was a functional or single-means claim, and that it was unpatentable over certain prior art patents cited by him, and also rejected claim 41 as being unpatentable over certain prior art patents cited by him. Thereupon, an appeal was duly taken by the plaintiffs from the decision of said Primary Examiner, rejecting claims 40 and 41, to the Board of Appeals of the United States Patent Office. Said Board in a decision dated June 2, 1934 affirmed the decision of the Primary Examiner and rejected said claims on the ground that the same failed to differentiate from a certain patent to Rankin, No. 838,273, and that said claims 40 and 41 were functional in form, all as will more fully appear from the decision of said Board of Appeals, or a legally authenticated copy thereof ready in court to be produced.

8. The plaintiffs aver that the decision of said Board of Appeals in rejecting said claims 40 and 41 and refusing the plaintiffs a patent on the inventions therein stated was erroneous and contrary to law, and that the plaintiffs are entitled under the laws of the United States to a patent for the inventions covered by said claims 40 and 41 as well as for the inventions covered by the other claims in said renewal application contained.

9. No appeal was taken by the plaintiffs from the decision of said Board of Appeals to the United States Court of Customs and Patent Appeals, or otherwise.

10. The defendant, Conway P. Coe, Commissioner of Patents, has refused and still refuses to grant Letters Patent to the plaintiffs for said inventions defined in said claims 40 and 41.

WHEREFORE, the plaintiffs pray:

1. That this court adjudge that the plaintiff, Raytheon Manufacturing Company, as mesne assignee of said Charles G. Smith, is entitled to receive Letters Patent of the United States for the aforesaid inventions specified in said claims 40 and 41, as well as for the inventions specified in said other claims which have been allowed by the Patent Office in said renewal application.

2. For such other and further relief as may seem meet and proper.

RAYTHEON MANUFACTURING COMPANY
CHARLES G. SMITH

By their Attorney,
ELMER J. GORN

COMMONWEALTH OF MASSACHUSETTS,
County of Middlesex, ss.

Charles G. Smith, being first duly sworn, deposes and says that he is one of the plaintiffs in the foregoing bill of complaint; that he has read said bill and knows the contents thereof; that the allegations contained in the said bill are true, except as to allegations made on information and belief, and that as to such allegations, he believes them to be true; and that he verily believes that he is the original, sole and first inventor of the inventions set forth in his applications for United States Letters Patent referred to in said bill and particularly specified in claims 40 and 41 thereof, as well as in the other claims therein included.

CHARLES G. SMITH

Subscribed and sworn to before me this 24th day of November, 1934.

HUBERT H. LEWIS
(N. S.) *Notary Public*

6 *Answer to the Bill of Complaint.*

Filed December 18 1934

* * * * * * * *

To the Honorable
The Judges of the Supreme Court
of the District of Columbia.

Conway P. Coe, Commissioner of Patents, defendant herein, in answer to the Bill of Complaint alleges on information and belief as follows:

1. He admits for the purpose of this suit the allegations of citizenship, residence and place of business of plaintiffs, and admits that Conway P. Coe is Commissioner of Patents, that his official residence is in the District of Columbia, and his legal residence is in the State of Maryland.

2. He admits the allegation of jurisdiction under Section 4915 R. S., 35 U. S. C. A. 63, as amended.

3. He admits the allegations of invention and the nonexistence of statutory bars in so far as they apply to the nine claims that have been allowed, but denies that they support the allowance of claims 40 and 41, which read as follows:

40. A gaseous discharge device comprising a tube containing a cathode, and means for retating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

41. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

4. He admits that on March 5, 1925, Charles G. Smith filed in the United States Patent Office an application for letters patent to which Serial No. 13,146 was given and which application was amended from time to time. 7

5. He admits that the application was allowed, became forfeited and was thereafter renewed and further amended.

6. He admits the allegations of assignment.

7. He admits that the primary examiner, on July 13, 1933, allowed claims 8, 22, 23, 28, 30, 31, 32, 33 and 38, but rejected claims 40 and 41, and that appeal was taken to the Board of Appeals on the rejection of claims 40 and 41, which Board of Appeals, on June 2, 1934, rendered a decision affirming the decision of the primary examiner.

8. He denies that plaintiffs are entitled to an allowance of claims 40 and 41, as they are held to be unpatentable over the patent to RANKIN, 838,273, granted December 11, 1906. As further showing the state of the art the following patents will be presented at the trial:

Fischer,	1,328,041	January 13, 1920,
Reisz,	1,059,763,	April 22, 1913.

Profert of copies of these patents is hereby made.

9. He admits that no appeal has been taken in this case to the United States Court of Customs and Patent Appeals.

10. He admits that the Commissioner of Patents has refused and still refuses to grant letters patent to plaintiffs for claims 40 and 41.

FURTHER ANSWERING defendant denies that plaintiffs are entitled to an allowance of claims 40 and 41, as more fully appears in the statement of the Examiner and the decision of the Board of Appeals, copies of which will be presented at the hearing.

WHEREFORE defendant having fully answered the Bill of Complaint denies that plaintiffs are entitled to
8 the relief demanded or any part thereof and prays that the Bill be dismissed with all costs of the proceedings against the plaintiffs as provided in Section 4915 R. S.

CONWAY P. COE
Commissioner of Patents, Defendant.

T. A. HOSTETLER,
Solicitor of the U. S. Patent Office,
Attorney for Defendant.

DISTRICT OF COLUMBIA: *ss.*

I, Conway P. Coe, Commissioner of Patents, depose and say that I have read the above answer by me subscribed and know the contents thereof, and that the statements of facts therein made as upon personal knowledge are true, and those made upon information and belief I believe to be true.

CONWAY P. COE
Commissioner of Patents.

Subscribed and sworn to before me this 17th day of December, 1934.

ALBERT W. KAISER
(SEAL) *Notary Public, D. C.*

My commission expires March 21, 1938.

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9 *Amendments to Bill of Complaint*

Filed January 24 1936

* * * * * * * *

NOW COME Plaintiffs and by leave of Court, granted January 24, 1936, file this their amendment to the Bill of Complaint.

Rewrite Section 8 of said Bill of Complaint to read as follows:

8. The plaintiffs aver that the decision of said Board of Appeals in rejecting said claims 40 and 41 and refusing the plaintiffs a patent on the inventions therein stated was erroneous and contrary to law, and that the plaintiffs are entitled under the laws of the United States to a patent for the inventions covered by said claims 40 and 41 as well as for the inventions covered by the other claims in said renewal application contained. The said claims 40 and 41 are as follows:

40. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

10 41. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

RAYTHEON MANUFACTURING COMPANY
CHARLES G. SMITH

By their Attorney
PAUL A BLAIR

DELOS G. HAYNES.
Of Counsel

Service of the above document and receipt of a copy thereof is hereby admitted this 24th day of January, 1936.

R. F. WHITEHEAD
Attorney for Defendant

11 *Memorandum of Court*

Filed February 3- 1936

* * * * * * * *

I agree with the opinion of the Board of Appeals of the Patent Office

The bill should be dismissed with costs.

BAILEY,
J.

---

12 *Findings of Fact*

Filed March 10 1936

* * * * * * * *

1. The issue of the present suit under 35 U. S. Code 63 is the patentability of the subject matter of claims 40 and 41 set forth in Paragraph 6 of the amended Bill of Complaint.

2. The Reisz patent, No. 1,059,763, discloses a relay for causing current to flow in one circuit in response to current flow in another circuit. It comprises a cathode K and an anode B. Electrons emitted from the cathode pass through an opening in the middle of anode B into the space between two electrodes *e* and *f*. In this space the electrons ionize the gas filling within the tube R, and the presence of the ions created permits a current flow between the electrodes *e* and *f*. A pair of coils *a-a* sets up a transverse magnetic field between the electrodes K and B. The transverse magnetic field deflects the electron beam from the cathode K so that the electrons miss the opening in the anode B, whereby they are prevented from entering the space between the electrodes *e* and *f*. Thus ionization is prevented between electrodes *e* and *f*, and current cannot flow between them. In this way the magnetic field, due to the coils *a-a*, controls the discharge between the electrodes *e* and *f*.

3. The Fischer patent, No. 1,328,041, discloses a
13 relay in which one circuit controls another. It consists of a tube having two electrodes *e-e* between which current will not flow unless ions are created in the space between them. A coil *t* surrounding the tube *r* in which the electrodes are placed is fed with high-frequency current which produces ionization in the gas within the tube *r*, and thus creates ions permitting a discharge to flow between the electrodes *e-e*. In this way the coil *t* controls the discharge between the electrodes *e-e*.

4. The Rankin patent, No. 838,273, discloses a cathode-ray tube consisting of a glass tube *a* containing a cathode *b* and an anode *c*. When a high voltage is placed between these electrodes, electrons are emitted from the cathode *b*, and travel out at a high speed past the anode *c* and through a small opening in the middle of the diaphragm *n*. These fast-moving electrons are cathode rays. The pencil of cathode rays continues past the diaphragm *n* and collides with a fluorescent screen *e* upon which it produces a luminous spot. The cathode-ray pencil can be deflected by external magnetic coils *m-m* and *k-k* so as to move the luminous spot on the fluorescent screen *e* in order to draw out any desired curve. A coil *r* is placed around the tube *a*, and sets up magnetic lines of force in the tube *a* parallel to the direc-

tion in which the electrons travel from the cathode *b* to the anode *c*.

5. The Ryan patent, No. 834,998, discloses a cathode-ray tube of the same type as shown in Rankin. The Rankin patent describes the invention shown therein as being an improvement of the cathode-ray tube shown in the Ryan patent. The Ryan patent differs from the Rankin patent only in that it omits the coil *r*.

6. Claim 40 at bar specifies:

14 A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

Such a construction is shown in the Smith application at bar. An advantage of this not shown in the prior art cited is "means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface", which means enables a low voltage discharge to be maintained between the cathode surface and the anode, thereby improving the efficiency of the device.

7. Claim 41 at bar specifies:

A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

Such a construction is shown in the Smith application at bar. An advantage of this not shown in the prior art cited is "means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface". This means enables a low voltage discharge to be maintained between the cathode and the anode, whereby the efficiency of the device is improved.

8. The prior art does not show the structure shown
15 in the application in suit; nor rotation of the dis-
charge adjacent the cathode surface to maintain a
high pressure adjacent said surface, specified in claim 40;
nor a magnetic field imparting gas movement for produc-
ing a high pressure in the region adjacent the cathode sur-
face, specified in claim 41.

Conclusions of Law

1. Plaintiffs are not entitled to an allowance of claims 40 and 41 because they differentiate from the prior art only by functional statements.

2. Plaintiffs are not entitled to a decree under 35 U. S. Code 63 for either of the claims submitted, and the Bill of Complaint will be dismissed with costs.

JENNINGS BAILEY
Justice

March 10th, 1936.

16 *Final Decree.*

Filed March 10 1936

* * * * * * * *

This cause having come on to be heard and having been tried in open court and argued by counsel for the respective parties upon the pleadings and proofs adduced and submitted to the Court,

It is ADJUDGED, ORDERED and DECREED this 10th day of March, 1936, that the Bill of Complaint in this case be, and the same hereby is dismissed with costs against the plaintiffs.

JENNINGS BAILEY
Justice.

Approved as to Form:
DELOS G. HAYNES
Attorney for Plaintiffs.

From the foregoing decree the plaintiffs, Raytheon Manufacturing Company and Charles G. Smith, in open court on the date named above, note an appeal to the United States Court of Appeals for the District of Columbia, and the Court fixes the cost bond on said appeal in the sum of $100, or in lieu thereof the sum of $50 in cash to be deposited with the Clerk of the Court.

JENNINGS BAILEY
Justice.

Memorandum

MARCH 26 - 1936.

$50 deposit in lieu of bond on appeal.

17 *Assignments of Error*

Filed April 10 1936

* * * * * * * *

Now come the plaintiffs in this cause and say that the decree entered in this cause on or about the tenth day of March, 1936, is erroneous and unjust to plaintiffs. And plaintiffs assign for errors in said decree the following matters, to-wit:

1. In decreeing that the bill of complaint be dismissed, whereas the Court should have granted the prayer of the bill of complaint.

2. In decreeing that the bill of complaint be dismissed, whereas the Court should have held that the inventions as recited in said claims distinguish effectively and patentably from said prior art.

3. In concluding (Conclusion of law No. 1) that the claims differentiate from the prior art only by functional statements.

4. In not concluding that the claims differentiate from the prior art by recitation of structural differences over the prior art.

5. In not concluding that the breadth of definition of the structural differences over the prior art is warranted by the breadth of applicant's invention. 18

WHEREFORE and for divers other errors appearing in said record, said plaintiffs pray that said decree be reversed and that said plaintiffs may have an adjudication and decree in their favor.

RAYTHERON MANUFACTURING COMPANY
and CHARLES G. SMITH
By DELOS G. HAYNES
Their Attorney

tween the cathode and the anode, whereby the efficiency of the device is improved.

8. The prior art does not show the structure shown
15 in the application in suit; nor rotation of the discharge adjacent the cathode surface to maintain a high pressure adjacent said surface, specified in claim 40; nor a magnetic field imparting gas movement for producing a high pressure in the region adjacent the cathode surface, specified in claim 41.

Conclusions of Law

1. Plaintiffs are not entitled to an allowance of claims 40 and 41 because they differentiate from the prior art only by functional statements.

2. Plaintiffs are not entitled to a decree under 35 U. S. Code 63 for either of the claims submitted, and the Bill of Complaint will be dismissed with costs.

JENNINGS BAILEY
Justice

March 10th, 1936.

16 *Final Decree.*

Filed March 10 1936

* * * * * * * *

This cause having come on to be heard and having been tried in open court and argued by counsel for the respective parties upon the pleadings and proofs adduced and submitted to the Court,

It is ADJUDGED, ORDERED and DECREED this 10th day of March, 1936, that the Bill of Complaint in this case be, and the same hereby is dismissed with costs against the plaintiffs.

JENNINGS BAILEY
Justice.

Approved as to Form:
DELOS G. HAYNES
Attorney for Plaintiffs.

From the foregoing decree the plaintiffs, Raytheon Manufacturing Company and Charles G. Smith, in open court on the date named above, note an appeal to the United States Court of Appeals for the District of Columbia, and the Court fixes the cost bond on said appeal in the sum of $100, or in lieu thereof the sum of $50 in cash to be deposited with the Clerk of the Court.

JENNINGS BAILEY
Justice.

Memorandum

MARCH 26 - 1936.

$50 deposit in lieu of bond on appeal.

---

17 *Assignments of Error*

Filed April 10 1936

* * * * * * * *

Now come the plaintiffs in this cause and say that the decree entered in this cause on or about the tenth day of March, 1936, is erroneous and unjust to plaintiffs. And plaintiffs assign for errors in said decree the following matters, to-wit:

1. In decreeing that the bill of complaint be dismissed, whereas the Court should have granted the prayer of the bill of complaint.
2. In decreeing that the bill of complaint be dismissed, whereas the Court should have held that the inventions as recited in said claims distinguish effectively and patentably from said prior art.
3. In concluding (Conclusion of law No. 1) that the claims differentiate from the prior art only by functional statements.
4. In not concluding that the claims differentiate from the prior art by recitation of structural differences over the prior art.
5. In not concluding that the breadth of definition of the structural differences over the prior art is warranted by the breadth of applicant's invention. 18

WHEREFORE and for divers other errors appearing in said record, said plaintiffs pray that said decree be reversed and that said plaintiffs may have an adjudication and decree in their favor.

RAYTHERON MANUFACTURING COMPANY
and CHARLES G. SMITH
By DELOS G. HAYNES
Their Attorney

19 Supreme Court of the District of Columbia

Thursday, April 30, 1936

The Court resumes its sessions pursuant to adjournments, the Justices sitting in Equity, presiding.

* * * * * * * *

Come now the parties hereto by their respective attorneys of record, and thereupon, the plaintiffs by their attorney present to the Court their Statement of Evidence taken at the trial of this cause, and pray that the same be signed and made of record, nunc pro tunc, which is hereby accordingly done.

JENNINGS BAILEY,
Justice.

---

20 *Designation of Record*

Filed April 10 1936

* * * * * * * *

TO THE CLERK:

Plaintiffs-appellants, by their attorney, designate the following to constitute the transcript of record on the appeal in the above-entitled cause:

1. Bill of complaint.
2. Answer to bill of complaint.
3. Amendment to bill.
4. Memorandum opinion.
5. Findings of fact and conclusions of law.
6. Decree, and order allowing appeal.
7. Assignments of Error, omitting the affidavit of service.
8. Memorandum of deposit of bond on appeal.
9. Statement of Evidence, exhibits therein specified, stipulation relating thereto, and order approving said Statement; but omitting the notice and the affidavit of service.
10. This designation, omitting the affidavit of service.

DELOS G. HAYNES
Attorney for Plaintiff

21 Supreme Court of the District of Columbia

UNITED STATES OF AMERICA,
District of Columbia, ss:

I, Frank E. Cunningham, Clerk of the Supreme Court of the District of Columbia, hereby certify the foregoing pages numbered from 1 to 20, both inclusive, to be a true and correct transcript of the record, according to directions of counsel herein filed, copy of which is made part of this transcript in cause No. 58006 in Equity, wherein Raytheon Manufacturing Company, of Newton, Massachusetts, and Charles G. Smith, of Medford, Massachusetts, are Plaintiffs and Conway P. Coe, Commissioner of Patents, is Defendant, as the same remains upon the files and of record in said Court.

IN TESTIMONY WHEREOF, I hereunto subscribe my name and affix the seal of said Court, at the City of Washington, in said District, this 17th day of June, 1936.

FRANK E. CUNNINGHAM,
Clerk.
C. E. STEWART, JR.,
(Seal) *Assistant Clerk.*

22 In the Supreme Court of the District of Columbia
In Equity No. 58,006.

RAYTHEON MANUFACTURING COMPANY and CHARLES G. SMITH, *Plaintiffs,*
vs.
CONWAY P. COE, Commissioner of Patents, *Defendant.*

Stipulation

It is hereby stipulated by and between counsel for the respective parties, this Honorable Court consenting, that the original exhibits may be used as part of the statement of evidence on the appeal to the Court of Appeals of the District of Columbia in the above-entitled cause; and that said statement of evidence is correct.

DELOS G. HAYNES
Attorney for Plaintiffs
R. F. WHITEHEAD
Attorney for Defendant

IT IS SO ORDERED:

JENNINGS BAILEY
Justice

24 In the Supreme Court of the District of Columbia

In Equity No. 58,006.

RAYTHEON MANUFACTURING COMPANY and CHARLES G. SMITH, *Plaintiffs*,

v.

CONWAY P. COE, Commissioner of Patents, *Defendant.*

Statement of Evidence

On the hearing of this cause before Mr. Justice Jennings Bailey on January 24, 1936, evidence on behalf of the respective parties, plaintiffs and defendant, was offered and given as hereinafter stated as follows:

Plaintiffs' counsel offered in evidence, as plaintiffs' exhibit 1, a certified copy of certain portions of the file-wrapper and contents of the Smith patent application, serial No. 13146, here involved.

Opening Statement on Behalf of Plaintiffs

By Mr. Haynes:

The patent application at bar relates, in general, to gaseous discharge devices. I have here a tube, which I am not offering in evidence. I merely have it here to illustrate what we mean by it. This is not made under the patent application in suit. I just happened to pick it up at the plaintiffs' factory. In this tube, current flows in in alternating directions. One purpose of the tube is to absorb or nullify half of the current, and let only current of one direction come out. It is commonly called a rectifier.

25 In such a tube there is a cathode connected to one terminal. There is an anode connected to another. There is some kind of gas—sometimes two kinds of gas—in the tube, and the current flows around in more or less mysterious ways to produce results—primarily, in this case, to produce a current of one direction, that is, direct current.

The loss of energy in a tube of this kind is an important factor, because whatever power is lost in here costs money, and heats or overheats the parts. So, for both reasons, it is desirable to keep down the internal losses. One factor of the present invention is that we can crowd more power through a tube of a given size without undue heating losses than in the references cited by the Patent Office. That means that we can built a tube for a given number of horse-power or kilowatt capacity, with less expense.

The limiting factor in these tubes is often the heating. You must not let them get too hot, or they will deteriorate.

26 Elmer Joseph Gorn

Elmer Joseph Gorn, a witness called on behalf of plaintiffs, being duly sworn, testified as follows:

Direct examination by Mr. Haynes:

My name is Elmer Joseph Gorn. I am 32 years old, I live at 123 Sutherland Road, Boston, Massachusetts.

I am a graduate electrical engineer. I am also a patent attorney specializing in electrical gaseous space discharge devices.

I was the attorney for the applicant in the Patent Office in this application. My appearance as counsel in this case has been withdrawn.

I graduated in 1925 with the degree of bachelor of science from the Sheffield Scientific School of Yale University. In securing that degree I specialized particularly in electrical engineering, and more particularly in communications, which included the study of space discharge tubes.

After graduating I became a member of the examining corps of the United States Patent Office and, except for the first few months, my work was confined solely to electrical engineering subjects.

For somewhat over five years I have been doing work for the Raytheon companies, including Raytheon Manufacturing Company, which is one of the plaintiffs in the case at bar.

27 This work included not only their patent work, but also assisting in the design and testing of electrical space discharge tubes. My duties also included keeping up with the development in the art along this particular line.

I have read the Smith patent application in suit, and particularly the portions contained in plaintiffs' exhibit 1. I understand the disclosure therein.

I have also read the patents to Rankin, No. 838,273; Fischer, No. 1,328,041; Reisz, 1,059,763; and Ryan, No. 834,998. I understand the disclosures of those patents. In analyzing or describing the disclosure of the invention as stated in the application at bar, plaintiffs' exhibit 1, the Smith patent application, it will be of assistance if we turn to page 27 of exhibit 1, which has the drawings, as amended, in this application.

The Smith invention relates primarily to a rectifier tube, as explained in plaintiffs' opening statement.

"Q Will you explain just briefly what a rectifier tube is? I say this in the interest of having the explanation in the record.

"The Court: You have made your statement, and the witness has adopted it. I think that is sufficient.

:Mr. Haynes: Thank you, your Honor."

28 The Smith rectifier at bar is intended to be a low voltage discharge device, that is, one in which the losses are slight, and the voltage or pressure which exists across the tube while it is conducting current is relatively low, of the order of 5 to 25 volts. The tube, being a rectifier, has impressed upon it an electrical pressure which tends to force current through it, and this pressure reverses, ordinarily, 60 times a second.

However, under this pressure the tube permits current to flow in but one direction, and, in order to accomplish this, the Smith tube is provided with a cathode C and an anode A. In order to carry this electricity through the space in between C and A, the inside surface of that cathode C pours out little particles of matter or electricity which we call electrons, and those electrons, being impelled by this electrical pressure, travel out through that opening in the top of cathode C, the opening being labeled E.

This flow of electrons or little particles of electricity or matter, between C and A, constitutes the flow of electric current.

A does not pour out these current carriers, so that if the electrical pressure reverses, all the particles fall back onto the cathode and there is nothing to carry the current. That is what makes it a rectifier.

29 In order to produce a low-voltage drop through the tube, it is necessary in this device to provide a gas, which may be mercury vapor, given off from the drop of mercury which is labeled D, at the bottom of the tube. The mercury vapor coming from D fills the interior of the tube T, and these electrons, in going through this vapor, collide with the individual atoms, to produce ionization and cause a

low voltage drop, and consequently a low loss in the tube.

In tubes of this kind, in order to secure as advantageous conditions as possible, it is desirable to have a high pressure or density of gas adjacent the interior surface of that cathode C and to have a low pressure or density of gas adjacent the anode surface. Those conditions are ideal, as nearly ideal as possible, to secure the maximum operation of the tube. In this particular tube there are shown and described means whereby the inventor secures this differential pressure, that is, a high pressure adjacent the cathode and a low pressure adjacent the anode.

This means is shown as a magnetic coil which is labeled M. This magnetic coil sets up lines of force which lie in a direction parallel to the axis of the tube, that is, the line along which these members a and c lie.

The current carriers, which come off the side wall of the cathode C, that is, the electrons, are emitted or poured out from that surface in a direction at right angles to the surface, and so they go out into the space at right angles to those magnetic lines of force which I have just described. Before the electrons get to the aperture E they have to come from some solid surface. They have to be poured out or emitted, as we term it, from a solid surface, and that solid surface, in this case, is the interior side wall of that member which is labeled C. They come from the side, and some also come from the upper inside of the part of the cathode which is labeled E. There are none that come from the lower side, the member P.

The electrons that come from the upper side are ineffective insofar as the phenomena which I am going to describe, and which form part of the invention, are concerned. They have no particular effect on those phenomena. The ones that do have the effect are the electrons which are emitted from the side walls, and they come out normal to the surface, perpendicular to that surface. When they come out in that way, they are traveling in a direction at right angles to the magnetic lines of force.

The electrons which would come from the top and bottom would not come at right angles; but the ones that perform the action are the ones coming from the side walls.

As these electrons come from the side walls and cross magnetic lines of force, they are pushed in a direction at right angles to the previous direction, that is, pushed in a direction at right angles to the paper here (indicating). The ones at the left are pushed down, and the ones at the right are pushed up, which gives a whirling action to the discharge, this box C being, incidentally, closed, and presumably circular.

31 That whirling action produces a whirling not only of these little particles, the electrons, but also of the gas inside the tube, because these little particles push the gas around with them.

The ionization produces additional current carriers, which we call positive ions, and they travel exactly in an opposite direction to the electrons, and will enter the side walls at right angles to the side walls of the cathode, and they likewise are pushed by this magnetic field, and the two types of particles, whirling around together, produce a very strong whirling of the gas inside that hollow box. This whirling action sets up centrifugal forces which increase the density of the gas adjacent those side surfaces, and that creates the condition which I have before described aa ideal for rectification.

If it will assist the Court in visualizing this action a little more vividly, I have prepared a little electrolytic analogy which I should like to demonstrate.

This (indicating) is a little simple electrolytic analogy to the tube. It is not a complete analogy, but it is merely for the purpose of making visual the type of action that occurs in this tube. The breaker corresponds to the glass envelope T. The ring, which is made of nickel, corresponds to the side walls of the cathode C—this ring around the bottom (indicating).

32 This little plate at the top corresponds to the anode A.

In the beaker I have put a solution of baking soda, which corresponds, roughly, to the gas or vapor in the tube.

Around the beaker I have placed a magnetic coil which corresponds to this magnetic coil M.

These other pieces of apparatus are merely auxiliary. This resistor simply is to prevent the fuses from blowing out, and limiting the current, and there is a light under here so that you can see it a little more readily.

As I turn on the switch, the current starts to flow between the anode and the cathode, and the interaction of the magnetic field, and that flow of current produces this whirling action in there (indicating). The whirling here is comparatively slow when compared to the whirling of the gases in the tube, because the liquid is quite viscous, and there is a resistance to the flow, but the gases are relatively less viscous. There is no resistance to the whirling, and they whirl around more rapidly, so this whirling occurs inside that ring, producing or throwing out the particles to the side and building up a high pressure adjacent the side.

I am now turning off the current, I am leaving the apparatus in its present position, in case counsel for the defendant wishes to use it in cross examination.

33 I will refer now to the two claims which are at bar, and will state how they apply to the portions of the Smith application drawings at bar:

Claim 40 can be applied to the Smith drawing as follows:

"A gaseous discharge device comprising a tube"—

that is the tube labeled T in the drawing—

"containing a cathode"—

that cathode being the member C—

"and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface".

That means the magnetic coil M, the action of which I have described and illustrated.

—"whereby a low voltage discharge may be maintained between said cathode surface and said anode."

(The above claim is called 40 in some parts of plaintiffs' exhibit 1, and it is called 10 in another part of said exhibit. It is an identical claim.)

I will proceed now to the other claim at bar. This claim is numbered sometimes 41, and sometimes 11, in plaintiffs' exhibit 1. This claim can be applied to the drawing of the application as follows:

"A unidirectional gaseous discharge device comprising"—

That phrase defines a rectifier, which the device is described as being, on page 4 of exhibit 1, lines 26 and 27, in which it is said that the gaseous discharge is

"restricted to one direction"

in starting with the cathode cold, and also in line 29
34 of the same page it is stated:

"The invention is particularly applicable to rectification of alternating current."

The claim continues:

—"an evacuated envelope"—

which is the tube T in the drawings.

By "Evacuated" I mean a tube in which the air is taken out. It is not evacuated so far as the mercury vapor is concerned, however.

Continuing with the above claim 41:

—"containing gas"—

that is, the mercury vapor, from the drop D.

—"a cathode having an extended discharge surface producing an electron discharge to said anode during operation"—

That is the cathode C, producing the discharge to the anode A.

—"and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface"—

That is the electromagnet M.

—"whereby a low voltage discharge may be maintained between said cathode surface and said anode."

As described in various places in the spacification: For example, on page 4, lines 6 and 7, it is stated:

"Thus the voltage drop is reduced to a low value."

Referring now to the patent to Reisz, No. 1,059,763:
35 This patent is a relay for causing currents to flow in one circuit in response to current flow in an indepen-

dent circuit; that is, one circuit controls the other. It consists of a cathode K and an anode B. The electrons coming from the cathode pass through an opening or hole in the middle of that anode B, and then they pass up into the space between the two electrodes e and f. In so doing, they bump into a lot of gas atoms and break them up into electrons and positive ions, and we call those particles current carriers. In this way a large number of current carriers are created in the space between e and f.

Then, if we put an electrical pressure between e and f, a current will flow between them, whereas, if those current carriers were absent, no current would flow.

In order to control the device Reisz uses a transverse magnetic field, set up by coils labeled a. That zigzag line represents a coil which sets up a magnetic field transversely to the tube. That magnetic field pushes the electron stream or beam which comes from the cathode K to one side or the other, so that it misses the hole in the member B, and never gets up into the space between e and f, and therefore cannot produce any current carriers there.

So, when this electron beam is pushed over to one side, the current flow between e and f stops. I see no similarity between this device and the Smith device, insofar as any change in gas pressure is concerned adjacent the cathode. I do not see any way in which the action which occurs in Reisz would produce any rotation or movement of the gas adjacent the cathode surface so as to build up a higher pressure adjacent that surface than that of the anode.

Referring now to the Fischer patent, 1,328,041:
36 This Fischer patent is likewise a relay, in which one circuit controls another circuit. It consists of a tube having two electrodes e e, between which current will not flow unless there is some external means for creating current carriers in the space between them. Fischer shows such an external means, consisting of a coil t, which surrounds the tube. When you feed a coil such as t with a high-frequency current, that produces an action which breaks up the gas molecules inside the tube, creating these current carriers.

So, if we supply high-frequency to the coil t, we create these current carriers, and a current will then flow between the electrodes e-e. Again I see no similarity between this tube and the Smith tube, insofar as any redistribution of gas is concerned. I see no way in which the coil t would produce a higher gas pressure adjacent one electrode than the other.

Referring now to the Rankin patent 838,273: This patent relates to what we ordinarily call a cathode-ray tube. I might explain what cathode rays are. A cathode ray consists of electrons which are emitted or come off a cathode, these electrons being accelerated by a high voltage, or high electrical pressure, and the anode is placed in such a way that as these electrons come up toward the anode at this high speed they miss it and continue on at this high speed until they reach what is usually a fluorescent screen. When a small pencil of these fast-moving electrons or cathode rays hits the screen it produces a luminous spot of light.

37 In Rankin there is shown such a tube. This tube has two electrodes shown most clearly in figure 2, b and c. Those are the two electrodes. They have impressed across them a very high voltage compared with the voltage in a tube such as Smith has. That voltage is of the order of 20,000 to 50,000 volts—very high voltage.

The order of magnitude of the voltage in the Smith tube is from 5 to 25 volts.

This voltage of the order of 20,000 to 50,000 volts is inherent in the Rankin device. For example, in the Rankin patent, on page 1, lines 103 to 108, he talks about difficulties which arise from the use of this kind of instrument because the high voltages cause conductivity in the atmosphere outside the tube. I am not quoting directly, but the portion reads as follows:

"One of the chief difficulties in the practical use of this instrument arises from the conductivity of the atmosphere around the terminals of the tube at the high voltages required to establish the pencil of cathode rays."

It may be interesting to know that in order to produce this discharge in the atmosphere it takes about 20,000 volts per inch, and in tubes of this kind the distance between the outside terminals is often greatly in excess of that, so the voltage is clearly of the order of thousands of volts, compared with a few volts in the other tube.

38 In Rankin there is provided means for concentrating his cathode rays into a small pencil which will go through the opening in the central portion of that member which is labeled n, and that means for focusing or

concentrating the rays into a small pencil is the magnetic coil r. That restricts the cathode rays to a very small pencil, which goes through the opening in the member n, and finally impinges on the screen E, which is a fluorescent screen, and produces a small spot of light on there.

The magnetic coils m-m, right near that shield n, will likewise deflect that little pencil of rays, and you can swing the spot back and forth on the screen E, and draw out whatever curve you want to, depending upon how you control the magnets m-m.

In the form that this Rankin tube would have to be built in order to operate, the cathode would have to be the electrode b, and the anode would have to be the electrode c. A curious thing occurs here, in that the Rankin patent has an error in the description. On page 1, lines 43 and 44, he has called the plate b the "anode" and plate c the "cathode". But throughout the rest of the disclosure he talks about cathode rays traveling out toward the screen E. If c were actually the cathode, the cathode rays would travel in exactly the opposite direction. That is, they would go off from c, and go out towards b, and never get to the screen E. The fact that this is in error, to my mind, is shown clearly by referring to this Ryan patent, 834,998. The
39 Rankin patent, on page 1, lines 100 to 102, says that
his apparatus is an improvement over that invented by Professor Harris J. Ryan. I looked for some Ryan patents on this point, and the only one I found was the one to which we have just referred. If you compare the two drawings, the drawings in the Rankin patent and in the Ryan patent, you will see that they are very similar, evidently made by the same draftsman. The attorney in the case is the same. The witnesses are the same. Ryan and Rankin live in the same town, and these applications were filed about a month apart. The wording in the specification of Rankin follows very closely the wording of the specification in Ryan, some paragraphs differing only in a word or two.

The wording, for example, in Ryan, on page 1, lines 39 and 40, is exactly the same as that in Rankin, in which it is stated, on page 1, lines 42-44:

—"and hereinafter the plate b will be called the 'anode' and plate c the 'cathode'."

Although the wording is the same, it appears that due to some inadvertence, probably a draftsman's error, the lettering on figure 2 of Rankin, insofar as electrodes b and c are concerned, is reversed, and someone has put the letter "b" on Rankin where the letter "c" is on Ryan, and the letter "c" on Rankin where the letter "b" is on Ryan.

If the device is arranged as in Ryan, you will get cathode rays which come from the cathode c, travel out through the opening in the shield n, and impinge on that fluorescent screen.

But if it is arranged as it is in Rankin, you will
40 not get any such result. You will not get any cathode
rays, although Rankin, of course, contemplates that
you do get them.

Even if you assumed that there was not any error in Rankin, you still do not get the same action that you do in the Smith device. Suppose c were actually the cathode in Rankin. The electrons would come off the surface at right angles and curve around and come out towards the electrode b.

In an electromagnet such as r the magnetic lines of force go through the middle, along lines parallel to the axis of the coil, but those lines, as they go out, curve out, because they have to meet outside. Each one is a complete ring, around one side or the other of the coil r, and those lines would curve out on the outside. So, actually, if you built the tube as it is shown in Rankin, the magnetic lines of force would coincide substantially with the line of travel of the electrons, and at no place would there be any substantial movement of the electrons at right angles to any of the lines of force. They would travel along the magnetic lines of force, and there would not be any displacement of those so as to produce a whirling motion of the gas adjacent the member which is labeled here c; and if we assume it is a cathode, there would not be any such whirling of the gas.

As a matter of fact, one thing that determines the magnitude of this whirling action is the magnitude of the current that goes through the device, and also the magnitude of the magnetic lines of force set up by the coil r. This cathode-ray tube of Rankin is essentially a very low current device. At page 1, line 78, he speaks of it being fed
by a Wimshurst machine. A Wimshurst machine is
41 something which is today practically a laboratory
curiosity. That is, it is a machine having a glass

disc which is whirled around between some fingers which point in toward it, and those fingers pick up static electricity off the surface of this glass plate. You cannot get very much power out of it, and the amount of current you can get out of it is of the order of milliamperes—a few thousandths of an ampere, under the voltages involved.

The Smith device, on the other hand, contemplates higher currents, of the order of amperes. Therefore the current in the Smith device is thousands of times the current in the Rankin device.

So, even if you could assume that there was any interaction between the current carriers and the magnetic field—which actually there is not—still the magnitude of the effect would be insignificant as compared to anything in Smith. So that I do not see how, in Rankin, by any interpretation that you can give to it, you would get any movement or whirling of the gas so as to build up or redistribute the gases in the tube, and produce a higher pressure adjacent the cathode rather than the anode.

The advantages of the Smith device, shown in plaintiffs' exhibit 1, as compared with the devices of the prior art to which I have referred are, (referring to the broader characteristics): The Smith device, when operated as a rectifier, carries thousands of times the current of any of these other devices. There cannot be any real direct comparison between efficiencies or anything of that kind, because the devices are so entirely different. If you tried
to operate any of the other devices as a rectifier, for
42 example, and then you tried to compare efficiencies,
of course, the efficiency of the Smith device would be many, many times greater than that of any of these other devices.

By Mr. Haynes: Plaintiffs offer in evidence as plaintiffs' exhibit 2, a copy of the Ryan patent 834,998.

Direct examination closed.

By Mr. Whitehead: No cross-examination.

(Witness excused).

By Mr. Haynes: Plaintiffs rest.

By Mr. Whitehead: I have no testimony to offer. I wish to hand up to your Honor, the usual folder (defendant's exhibit 1). This contains the following:

A: Rankin patent 838,273
B: Reisz patent 1,059,763

C: Fischer patent 1,328,041.
D: Prints of drawings
E: Examiner's statement
F: Decision of Board of Apeals.

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43 The foregoing is a true and correct statement in substance of all the evidence offered on the hearing of the above entitled cause on behalf of the parties plaintiff and defendant as offered, given and received in open Court, and the same is accordingly approved as such to become and be part of the record on the appeal in the said cause, according to the provisions of the rule of Court in such case made and provided, this 30th day of April, 1936.

JENNINGS BAILEY
Justice

45 Pltffs Ex 1 58006

Department of Commerce

United States Patent Office

To all persons to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the records of this office of the Petition, Specification, Oath and Drawing, as originally filed; Original Petition; Specification and Drawing, as amended, June 22, 1933; Original Oath; Petition for Renewal, filed June 22, 1933; Letter of Examiner, dated July 13, 1933; Decision of Board of Appeals, dated June 2, 1934; and Back of File Wrapper, in the matter of the

Pending Application of

Charles G. Smith,

Filed March 5, 1925, Serial Number 13,146,

Renewed June 22, 1933,

for

Improvement in Electric Device.

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this ninth day of January, in the year of our Lord one thousand nine hundred and thirty-six and of the Independence of the United States of America the one hundred and sixtieth.

CONWAY P. COE,
Commissioner of Patents.

(Seal)

Attest:
D. E. WILSON,
Chief of Division.

46 Mail Room
Mar
5
1925
U. S. Patent Office

Petition.

To the Commissioner of Patents:

Your petitioner Charles G. Smith, a citizen of the United States of America and resident of Medford in the County of Middlesex and State of Massachusetts whose postoffice address is c/o American Appliance Co., Kendall Square, Cambridge, Massachusetts prays that Letters Patent may be granted to him for the improvement in ELECTRIC DEVICE as set forth in the annexed specification; and he hereby appoints Odin Roberts, Robert Cushman and Charles D. Woodberry, constituting the firm of

Roberts, Roberts & Cushman,

(Reg. No. 8510), 31 Milk Street, Boston, Massachusetts, his attorneys, with full power of substitution and revocation, to sign his name to the drawings, to prosecute this application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

CHARLES G. SMITH

Revenue Stamp

Specification.

To all whom it may concern:

Be it known that I, Charles G. Smith, a citizen of the United States of America and resident of Medford in the County of Middlesex and State of Massachusetts have invented new and useful improvements in ELECTRIC DEVICE of which the following is a specification:—

This invention relates to electronic discharge
47 devices having a cathode and an anode, with or without a third electrode for controlling the flow of current between the cathode and anode, for use as rectifiers, oscillaters, amplifiers, detectors, modulators, etc.

Particular objects of the invention are to pass current at a low potential difference between cathode and anode, to avoid excessive heating of the electrodes and associated parts by the cathode-anode current to produce ample electronic emission from the cathode, to direct the electronic discharge to the anode with minimum resistance, to avoid the necessity of using large quantities of vapor yielding material, to prevent electronic conduction from anode to cathode in response to reverse potential as in rectifying, and in some cases to eliminate the space charge in the region of the anode.

In one aspect the invention comprises a low pressure or high vacuum tube (of the order of .01 mm. of mercury e. g.) containing a cathode having a much higher pressure (of the order of .1 mm. of mercury e. g.) maintained in the region of its discharge surface by electric forces (electrostatic and/or magnetic) for the purpose of obtaining ample electronic emission. This difference of pressure is maintained by an obstruction between the electron source and the electron receiving area, the obstruction having an opening therethrough for the passage of electrons and the opening being so restricted that a difference of pressure (or state of ionization) may be maintained on opposite sides of the obstruction. As will appear hereinafter the obstruction is preferably formed as a part of the cathode. According to the present invention the aforesaid difference in pressure may be maintained by centrifugal action, preferably pro-

duced by a magnetic field extending longitudinally of
48 the axis of said opening, the field reacting with the
electric discharge to whirl the molecules (or atoms) of gas and build up a higher pressure near the inner periphery of the hollow cathode.

In another aspect the invention involves the use of gases having different facility of ionization or ionization voltages and the maintenance of a higher proportion of the more ionizable gas in the region of the electron source (e. g. inside the hollow cathode) than in the region of the anode or other electron receiving region. This is preferably accomplished by means of a porous or semipermeable wall or membrane, formed for example of carbon or quartz, or metal with holes small enough to restrict the gaseous transfer to the type known as pure diffusion, through which the less ionizable gas may escape from the cathode (preferably solely by the phenomenon of diffusion) without permitting the more ionizable gas to escape so readily or at all. For example, by using a mixture of helium and mercury vapor with a quartz wall, the helium escapes while the more ionizable mercury vapor cannot pass through the quartz wall and therefore accumulates in the cathode. Inasmuch as helium has a diffusion rate more than seven times that of mercury vapor the pressure of mercury vapor inside the cathode can be caused to preponderate greatly over its pressure outside the cathode even when using a porous wall of carbon which will pass the mercury vapor to some extent. For certain classes of work the vacuum tube may be filled with helium to a pressure of the order of one-half centimeter of mercury and a small quantity of mercury (as little as a single drop in small tubes) may be incorporated in the tube to supply the mercury vapor. The ionization voltages of mercury and helium are ten and one-half volts and twenty-five volts respectively.

Thus the gas in the cathode may be more intensely
49 ionized and thereby afford a lower voltage drop between the electrodes. The effect may be accentuated by intensely heating the gas in the cathode (e. g. 2800° C. or higher) as disclosed for example in my copending application filed on even date herewith and in Serial No. 696,337. With the gas inside the cathode at high temperature many of the atoms are in an excited state, that is their electrons

are displaced from their orbits near the atomic neucli to more remote orbits without being entirely removed from the influence of the neucli, and consequently electrons flowing from the inner surface of the cathode readily ionize the gas in the cathode. Thus the voltage drop is reduced to a low value.

While other gases having different ionizing and diffusing characteristics offer the same general advantages (e. g. hydrogen may be used instead of helium and caesium vapor, krypton or xneon may be used instead of mercury vapor) the above combination of gases offers special advantages. For example, helium offers a long means free path as disclosed in Serial No. 464,385 and mercury may be incorporated in liquid form thus insuring practically an inexhaustable supply of vapor.

In still another aspect the invention involves shielding the anode from positive ion bombardment during the portion of the cycle in which the current to the anode is small (e. g. in a rectifying tube, during the half-cycle in which the anode is negative), whereby the gaseous discharge between the electrodes is more effectively restricted to one direction in starting with the cathode cold, the helium shielding the anode from excessive bombardment by mercury ions during the half-cycles of reverse voltage.

The invention is particularly applicable to the rectification of alternating current and rectifiers incorporating the invention are characterized by low voltage drop even when rectifying current of moderately high voltage, (e. g. one thousand volts and upward). For the purpose of illustrating the invention is shown as applied to a rectifier in the accompanying drawing in which the figure represents, more or less diagrammatically, a longitudinal axial section of a rectifying tube comprising an anode A, a cathode C, a shield S, a tube T and an electro-magnet M encircling the tube. The aforesaid parts are preferably cylindrical in transverse section and coaxial. The tube T may be formed of hard or highly refractory glass and the electrodes A and C and the shield S of tungsten or other suitable material; and the electrodes and shield may be supported in the tube by any suitable means, stems *a, c,* and *s,* being shown for that purpose. D represents a drop of mercury or other vapor yielding material for supplying, either by normal evaporization or by application of external heat (e. g. with a heating coil H), one of the aforesaid gases. When employing helium at approximately one-half centimeter pressure a drop of mercury will afford a suitable proportion of mercury vapor in the tube. P designates the porous or semi-permeable membrane or wall hereinbefore referred to. When using helium and mercury this wall is preferably formed of quartz, to permit the diffusion of helium therethrough without passing the mercury vapor, and it may be anchored over the lower end of the hollow cathode C in any suitable manner.

With a suitable potential impressed between the cathode C and anode A current flows from the interior of the hollow cathode through openings E and L to the anode, the shield S serving to localize the heat produced in the cathode by the current flow and thereby augmenting ionization within the cathode as described in the aforesaid copending applications.

The shield S also serves to localize the current flow
51 along a restricted path. When the magnet M is energized
the field thereby produced reacts with the field produced by said current, thereby rotating the gas inside the cathode. This rotation of the gas produces a higher pressure adjacent the inner periphery of the cathode, thereby affording a higher state of ionization at the active surface of the cathode and facilitating electronic emission therefrom. By extending the stem *c* through the center of the cathode to a point adjacent the opening E, the gas inside the cathode is more effectively trapped and prevented from flowing out of the cathode along the axis thereof. Indeed this construction results in gas flow into the cathode through opening E, which is in the nature of a continuous pumping action, thereby maintaining a higher average pressure inside the cathode than outside.

Owing to the fact that the less ionizable gas (e. g. helium) diffuses through the wall P the gas trapped in the hollow cathode is predominantly the more ionizable component (e. g. mercury vapor), thereby further favoring current flow from the interior of the cathode. When the more ionizable gas is also heavier than the less ionizable gas (as mercury vapor is heavier than helium) the preponderance of the more ionizable gas adjacent the inner periphery of the hollow cathode is further augmented by the aforesaid centrifugal action.

The combined effect of the aforesaid factors, conducing to a high state of ionization inside the cathode, is to make the interior of the hollow cathode a markedly effective source of electrons as disclosed in my copending application filed herewith this effect may be further accentuated by heating the cathode independently of the current flow between cathode and anode and/or by coating the interior surface of the cathode with a high electron emitting material such
as caesium. The cathode may also be maintained at
52 a higher temperature by making its outer surface
and/or the inner surface of the shield S highly reflecting. By making the inner surface of the cathode bright less light is absorbed by the cathode and ionization inside the cathode is further augmented.

For some purposes the present invention may advantageously incorporate the mean free path principle disclosed in my prior applications Serial No. 406,886, 415,536, 526,095 etc., in which case the distance between cathode C and shield S and/or between shield S and anode A should be confined substantially to the mean free path of electrons in the gas in these spaces, that is, the average distance traveled by an electron at ionizing velocity without ionizing impact with a gas molecule.

From the foregoing it is evident that the top portion of the cathode surrounding the opening E constitutes an obstruction between the electron emitting periphery of the cathode and the electron receiving surface of the anode, and restricts the current flow to the opening E.

53 I CLAIM:

1. An electric device comprising a tube containing gas, an electron receiving area, a source of electronic discharge, an obstruction between said area and source having a restricted electronic discharge opening therein, and means including a magnet for maintaining different pressures on opposite sides of said obstruction.

2. An electric device comprising a tube containing gas, an electron receiving area, a source of electronic discharge, an obstruction between said area and source having a restricted electronic discharge opening therein, and means including an electro-magnet encircling the axis of said opening for

maintaining different pressures on opposite sides of said obstruction.

3. An electric device comprising a tube containing gas, an electron receiving area, a source of electronic discharge, an obstruction between said area and source having a restricted electronic discharge opening therein, and means for rotating the gas on one side of said obstruction to create a region of higher pressure by centrifugal action.

4. An electric device comprising a tube containing gas, an obstruction having restricted electric discharge opening therein, an electron receiving area on one side of said obstruction, a source of electronic discharge on the other side of said obstruction, and means for maintaining a difference of pressure on opposite sides of said obstruction, said means comprising means for rotating the gas on the first side of the obstruction to create a region of higher pressure by centrifugal action.

5. An electric device comprising a tube containing
54 gas and a hollow electrode having an electric discharge opening therein, and means for rotating the gas inside the electrode about an axis extending through the electrode.

6. An electric device comprising a tube containing gas and a hollow electrode having a restricted electric discharge opening therein, and means for maintaining a difference in pressure between the inside and the outside of the electrode including a magnet for producing a field inside the electrode.

7. An electric device comprising a tube containing gas and a hollow electrode having a restricted electric discharge opening therein, and means for maintaining a difference in pressure between the inside and the outside of the electrode including an electro-magnet encircling the electrode.

8. An electric device comprising a tube containing gas and a hollow electrode having an electric discharge opening in one side thereof, the opening being smaller than the side and located in the central region thereof, and electric means for rotating the electric discharge about an axis extending through said opening, thereby to maintain by centrifugal action a pressure inside the electrode higher than outside the cathode.

9. An electric discharge device comprising a tube con-

taining gas and a hollow electrode having an electric discharge opening in one side thereof, and a radiation shield outside the cathode, the distance between the cathode and shield being of the order of the mean free path of electrons in the space therebetween.

10. An electric device comprising a tube containing
55 gas and a hollow electrode having an electric discharge opening in one side thereof, the opening being smaller than the side and located in the central region thereof, means for maintaining a pressure inside the electrode higher than outside the electrode including a magnet for maintaining a field inside the electrode.

11. An electric device comprising a tube containing gas and a hollow electrode having an electric discharge opening in one side thereof, the opening being smaller than the side and located in the central region thereof, means for maintaining a pressure inside the electrode higher than outside the electrode including an electro-magnet encircling the axis of said opening.

12. An electric device comprising a tube containing gas and a hollow cathode having an electric discharge opening in one side thereof, passage of gas out of the cathode being obstructed on all sides except said side, said opening being smaller than said side and located in the central region thereof, and means for rotating the gas inside the cathode about an axis extending through said opening.

13. An electric device comprising a tube containing gas and a hollow cathode having an electric discharge opening in one side thereof, passage of gas out of the cathode being obstructed on all sides except said side, said opening being smaller than said side and located in the central region thereof, and means for creating a magnetic field longitudinally of said opening to rotate the gas inside the cathode about an axis extending through said opening.

14. An electric device comprising a tube containing
56 gas and a hollow cathode having an electric discharge opening in one side thereof, passage of gas out of the cathode being obstructed on all sides except said side, said opening being smaller than said side and located in the central region thereof and means for maintaining a pressure inside the cathode including a magnet for producing a field inside the cathode.

15. An electric device comprising a tube containing gas and a hollow cathode having an electric discharge opening in one side thereof, passage of gas out of the cathode being obstructed on all sides except said side, said opening being smaller than said side and located in the central region thereof and means for maintaining a pressure inside the cathode including an electro-magnet surrounding the axis of said opening.

16. An electric discharge device comprising a tube containing gases having different ionization voltages, a cathode having an electric discharge opening therein, an anode on one side of said opening, and means for maintaining a higher density of the more ionizable gas on the opposite side of said opening.

17. An electric discharge device comprising a tube containing gases having different ionization voltages, an electrode having an electric discharge opening therein, a second electrode on one side of said opening, and means for maintaining a difference in density of the more ionizable gas on the opposite sides of said opening.

18. An electric discharge device comprising a tube containing gases having different ionization voltages, a hollow cathode having an electric discharge opening therein, and means for maintaining a higher density of the more ionizable gas inside the hollow cathode than outside.

19. An electric discharge device comprising a tube
57 containing an easily ionizable gas and a gas less easily ionizable but more diffusible, a hollow cathode having an electric discharge opening therein, and means for flowing said gases into the cathode, said cathode having an obstructed passageway through which the latter gas may escape more rapidly, whereby a larger proportion of the first gas relative to the second gas is maintained inside the cathode.

20. An electric discharge device comprising a tube containing an easily ionizable gas and a gas less easily ionizable but more diffusible, a hollow cathode having an electronic discharge opening therein, and means for flowing said gases into the cathode, said cathode having a porous wall through which the latter gas may escape more rapidly, whereby a larger proportion of the first gas relative to the second gas is maintained inside the cathode.

21. An electric discharge device comprising a tube containing an easily ionizable gas and a gas less easily ionizable but more diffusible, a hollow cathode having an electronic discharge opening therein, and means for flowing said gases into the cathode, said cathode having a differentially permeable membrane through which the latter gas may escape more rapidly, whereby a larger proportion of the first gas relative to the second gas is maintained inside the cathode.

Signed by me at Boston, Massachusetts this
58 twenty-sixth day of February 1925.

CHARLES G. SMITH

Oath.

State of Massachusetts,
County of Suffolk, ss:

Charles G. Smith the above-named petitioner, being sworn, deposes and says that he is a citizen of the United States of America and resident of Medford, Massachusetts that he verily believes himself to be the original, first, and sole inventor of the improvement in ELECTRIC DEVICE described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by him or his representatives or assigns in any country foreign to the United States.

CHARLES G. SMITH.

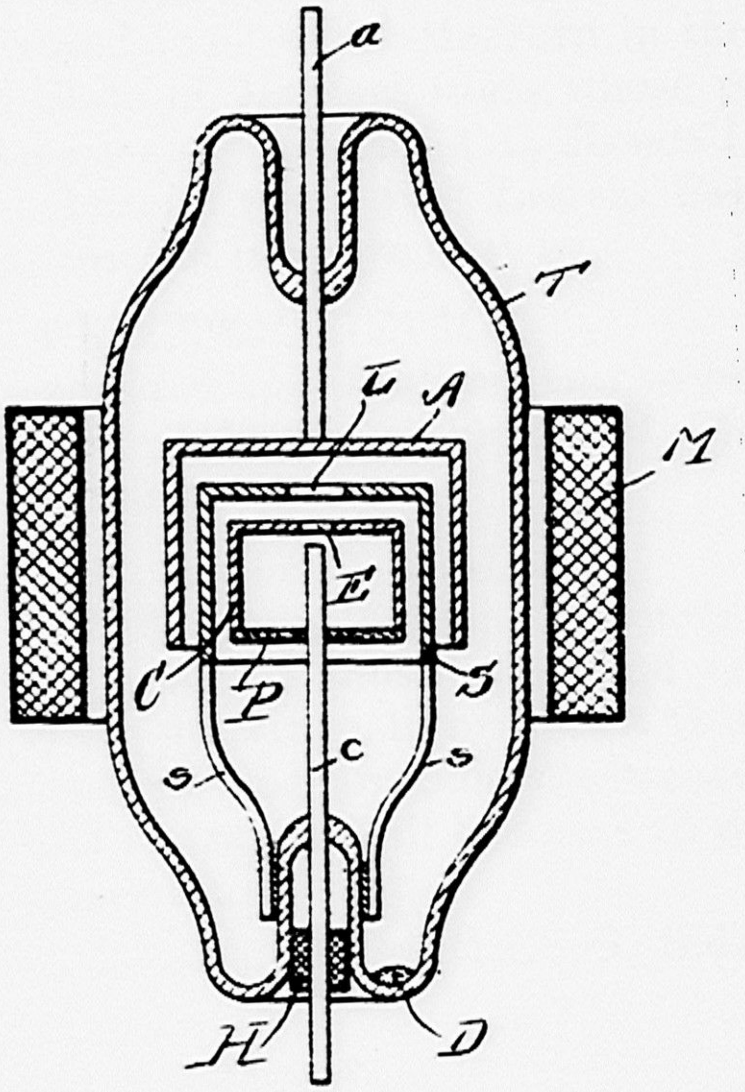
Subscribed and sworn to before me this 26th day of February 1925.

CHAS S GROVER
Notary Public

(Seal)

(Here follows photostat marked page 59.)

T 63



Inventor:
Charles G. Smith,
by Roberts, Roberts + Cushman
Attys.

60 Mail Room
Mar
5
1925
U. S. Patent Office

Petition.

To the Commissioner of Patents:

Your petitioner Charles G. Smith, a citizen of the United States of America and resident of Medford in the County of Middlesex and State of Massachusetts whose post-office address is c/o American Appliance Co., Kendall Square, Cambridge, Massachusetts prays that Letters Patent may be granted to him for the improvement in

ELECTRIC DEVICE

as set forth in the annexed specification; and he hereby appoints Odin Roberts, Robert Cushman and Charles D. Woodberry, constituting the firm of

Roberts, Roberts & Cushman,

(Reg. No. 8510), 31 Milk Street, Boston, Massachusetts, his attorneys, with full power of substitution and revocation, to sign his name to the drawings, to prosecute this application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

CHARLES G. SMITH

Revenue Stamp

Specification.

To all whom it may concern:

Be it known that I, Charles G. Smith, a citizen of the United States of America and resident of Medford in the County of Middlesex and State of Massachusetts have invented new and useful improvements in

ELECTRIC DEVICE

of which the following is a specification:—

This invention relates to gaseous discharge de-
61 vices in which ionization is a substantial factor and
in which the current density is substantially in ex-

cess of that in a glow discharge device. My invention is particularly applicable for use as rectifiers.

Particular objects of the invention are to pass current at a low potential difference between cathode and anode, to avoid excessive heating of the electrodes and associated parts by the cathode-anode current, to produce ample electronic emission from the cathode, to direct the electronic discharge to the anode with minimum resistance, to avoid the necessity of using large quantities of vapor yielding material, to prevent electronic conduction from anode to cathode in response to reverse potential as in rectifying, and in some cases to eliminate the space charge in the region of the anode.

In one aspect the invention comprises a low pressure or high vacuum tube (of the order of .01 mm. of mercury e. g.) containing a cathode having a much higher pressure (of the order of .1 mm. of mercury e. g.) maintained in the region of its discharge surface by electric forces (electrostatic or magnetic or both) for the purpose of obtaining ample electronic emission. This difference of pressure is maintained by an obstruction between the electron source and the electron receiving area, the obstruction having an opening therethrough for the passage of electrons and the opening being so restricted that a difference of pressure (or state of ionization) may be maintained on opposite sides of the obstruction. As will appear hereinafter the obstruction is preferably formed as a part of the cathode. According to the present invention the aforesaid difference in pressure
may be maintained by centrifugal action, preferably
62 produced by a magnetic field extending longitudi-
nally of the axis of said opening, the field reacting with the electric discharge to whirl the molecules (or atoms) of gas and build up a higher pressure near the inner periphery of the hollow cathode.

In another aspect the invention involves the use of gases having different facility of ionization or ionization voltages and the maintenance of a higher proportion of the more ionizable gas in the region of the electron source (e.g. inside the hollow cathode) than in the region of the anode or other electron receiving region. This is preferably accomplished by means of a porous or semipermeable wall or membrance, formed for example or carbon or quartz, or metal with holes small enough to restrict the gaseous transfer to the type known as pure diffusion, through which the less ionizable gas may escape from the cathode (preferably solely by the phenomenon of diffusion) without permitting the more ionizable gas to escape so readily or at all. For example, by using a mixture of helium and mercury vapor with a quartz wall, the helium escapes while the more ionizable mercury vapor cannot pass through the quartz wall and therefore accumulates in the cathode. Inasmuch as helium has a diffusion rate more than seven times that of mercury vapor the pressure of mercury vapor inside the cathode can be caused to preponderate greatly over its pressure outside the cathode even when using a porous wall of carbon which will pass the mercury vapor to some extent. For certain classes of work the vacuum tube may be filled with helium to a pressure of the order of one-half centimeter of mercury and a small quantity of mercury (as little as a single drop in small tubes) may be incorporated in the tube to supply the mercury vapor. The ionization voltages of mercury and helium are ten and one-half volts and twenty-five volts respectively.

Thus the gas in the cathode may be more intensely
63 ionized and thereby afford a lower voltage drop between the electrodes. The effect may be accentuated by intensely heating the gas in the cathode (e.g. 2800° C. or higher) as disclosed for example in my copending application Serial No. 13,145 filed on even date herewith and in Serial No. 696,337 filed March 1, 1924. With the gas inside the cathode at high temperature many of the atoms are in an excited state, that is their electrons are displaced from their orbits near the atomic nuclei to more remote orbits without being entirely removed from the influence of the nuclei, and consequently electrons flowing from the inner surface of the cathode readily ionize the gas in the cathode. Thus the voltage drop is reduced to a low value.

While other gases having different ionizing and diffusing characteristics offer the same general advantages (e.g. hydrogen may be used instead of helium and caesium vapor, krypton or xneon may be used instead of mercury vapor) the above combination of gases offers special advantages. For example, helium offers a long mean free path as disclosed in Serial No. 464,358 now patent No. 1,617,174, granted February 8, 1927 and mercury may be incorporated in liquid form thus insuring practically an inexhaustable supply of vapor.

In still another aspect the invention involves shielding the anode from positive ion bombardment during the portion of the cycle in which the current to the anode is small (e.g. in a rectifying tube, during the half-cycle in which the anode is negative), whereby the gaseous discharge between the electrodes is more effectively restricted to one direction in starting with the cathode cold, the helium shielding the anode from excessive bombardment by mercury ions during the half-cycles of reverse voltage.

The invention is particularly applicable to the rectification of alternating current and rectifiers incorporating the invention are characterized by low voltage drop even
64 when rectifying current of moderately high voltage,
(e.g. one thousand volts and upward). For the purpose of illustration the invention is shown as applied to a rectifier in the accompanying drawing in which the figure represents, more or less diagrammatically, a longitudinal axial section of a rectifying tube comprising an anode A, a cathode C, a shield S, a tube T and an electro-magnet M encircling the tube. The aforesaid parts are preferably cylindrical in transverse section and coaxial. The tube T may be formed of hard or highly refractory glass and the electrodes A and C and the shield S of tungsten or other suitable material; and the electrodes and shield may be supported in the tube by any suitable means, stems, *a*, *c*, and *s* being shown for that purpose. D represents a drop of mercury or other vapor yielding material for supplying, either by normal evaporization or by application of external heat (e.g. with a heating coil H), one of the aforesaid gases. When employing helium at approximately one-half centimeter pressure a drop of mercury will afford a suitable proportion of mercury vapor in the tube. P designates the porous or semi-permeable membrance or wall hereinbefore referred to. In the event membrane P comprises quartz or other insulating material, a conductor X is necessary between cathode C and stem *c*; this lead is desirable, though not necessary, in case member P is a semi-conductor, as carbon. When using helium and mercury this wall is preferably formed of quartz, to permit the diffusion of helium

therethrough without passing the mercury vapor, and it may be anchored over the lower end of the hollow cathode C in any suitable manner.

With a suitable potential impressed between the cathode C and anode A an electron stream flows from the interior of the hollow cathode through openings E and L to the anode, the shield S serving to localize the heat produced in the cathode by the current flow and thereby augmenting ionization within the cathode as described in the aforesaid copending applications. The shield S also serves to localize the current flow along a restricted path. When the magnet M is energized the field thereby produced reacts with the field produced by said current, thereby rotating the gas inside the cathode. This rotation of the gas produces a higher pressure adjacent the inner periphery of the cathode, thereby affording a higher state of ionization at the active surface of the cathode and facilitating electronic emission therefrom. By extending the stem *c* through the center of the cathode to a point adjacent the opening E, the gas inside the cathode is more effectively trapped and prevented from flowing out of the cathode along the axis thereof. Indeed this construction results in gas flow into the cathode through opening E, which is in the nature of a continuous pumping action, thereby maintaining a higher average pressure inside the cathode than outside.

Owing to the fact that the less ionizable gas (e.g. helium) diffuses through the wall P the gas trapped in the hollow cathode is predominantly the more ionizable component (e.g. mercury vapor), thereby further favoring current flow from the interior of the cathode. When the more ionizable gas is also heavier than the less ionizable gas (as mercury vapor is heavier than helium) the preponderance of the more ionizable gas adjacent the inner periphery of the hollow cathode is further augmented by the aforesaid centrifugal action.

The combined effect of the aforesaid factors, conducing to a high state of ionization inside the cathode, is to make the interior of the hollow cathode a markedly effective source of electrons as disclosed in my copending application Serial No. 13,145 filed herewith. This effect may be further accentuated by heating the cathode indepen-

66 dently of the current flow between cathode and anode or by coating the interior surface of the cathode with a high electron emitting material such as caesium. The cathode may also be maintained at a higher temperature by making its outer surface or the inner surface of the shield S highly reflecting or both. By making the inner surface of the cathode bright less light is absorbed by the cathode and ionization inside the cathode is further augmented.

For some purposes the present invention may advantageously incorporate the mean free path principle disclosed in my prior applications Serial No. 406,886, 415,536, 526,095 etc., now patent No. 1,545,207, granted July 7, 1925 and patents No. 1,617,171 and No. 1,617,179, granted February 8, 1927 in which case the distance between cathode C and shield S or between shield S and anode A or both should be confined substantially to the mean free path of electrons in the gas in these spaces, that is, the average distance traveled by an electron at ionizing velocity without ionizing impact with a gas molecule.

From the foregoing it is evident that the top portion of the cathode surrounding the opening E constitutes an obstruction between the electron emitting periphery of the cathode and the electron receiving surface of the anode, and restricts the current flow to the opening E.

The features of invention relating to the mounting of the shield around the anode and the spacing between the shield and the adjacent electrodes are not claimed in this application, but in my co-pending applications Serial No. 55,262, filed September 9, 1925, and Serial No. 76,792, filed December 21, 1925, which are as to these features continuations of the present application. The features of invention relating broadly to the use of two gases having different ionizing voltages, and the maintenance of the gas having a
67 lower ionization voltage at higher density adjacent the cathode surface than in the anode region, are likewise not claimed in the present application, but are made the subject matter of my co-pending application Serial No. 55,262, filed September 9, 1925, which is in this respect a continuation of the present application.

I CLAIM:

1. A gaseous discharge device comprising a tube containing gas an anode and a hollow cathode having a discharge

opening in one side thereof, the opening being smaller than the side and located in the central region thereof, and means for rotating the discharge about an axis extending through said opening, thereby to maintain by centrifugal action a pressure inside the cathode higher than outside the cathode.

2. A gaseous discharge device comprising a tube containing an easily ionizable gas and a gas less easily ionizable but more diffusable, an anode, a hollow cathode having a discharge opening therein, said cathode having an obstructed passageway through which the less easily ionizable gas may escape more rapidly than the other gas, whereby when a discharge occurs, said gases will be pumped into the hollow cathode and allow the less easily ionizable gas to escape.

3. A gaseous discharge device comprising a tube containing an easily ionizable gas and a gas less easily ionizable but more diffusable, an anode, a hollow cathode having a discharge opening therein, said cathode having a porous wall through which the latter gas may escape more readily whereby when the discharge occurs, said gases are pumped into the cathode permitting the less easily ionizable gas to escape.

68 4. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, an anode in said envelope, a cathode having an extended discharge surface producing an electron discharge to the anode during operation, means constituting an enclosure confining a body of gas adjacent said discharge surface, said enclosure having a restricted opening for passing the discharge between said discharge surface and said anode, and means for producing a magnetic field in the region of the discharge from said cathode surface to said opening to impart a gas movement in said envelope for producing a higher pressure in the region adjacent said cathode surface than in the region of said anode.

5. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, an anode in said envelope, means constituting a hollow chamber having a restricted central opening, a cathode element having an electron-emitting surface disposed adjacent the periphery of said chamber producing an electron discharge to the anode

during operation, and means for producing a magnetic field in the region of the electron flow from said electron-emitting surface to said restricted opening to give said electrons a movement at which they impart to the gas molecules within said chamber a rotary motion resulting in centrifugal compression of the gas in said chamber adjacent said emitting surface.

6. A unidirectional space current discharge device comprising an evacuated envelope containing a gas, a portion of which is more ionized during discharge than another portion of it, an anode, a cathode structure having a discharge surface and constituting an enclosure confining a body of gas in said envelope adjacent said discharge surface, said enclosure having an opening for passing the discharge to said anode and having portions more permeable to the gas portion that is not ionized than to the gas portion that is ionized.

7. A unidirectional space current discharge device
69 comprising an evacuated envelope containing a filling of easily ionizable gas and a difficult-to-ionize gas, an anode, a cathode structure having a discharge surface and constituting an enclosure confining a body of said gas filling in said envelope adjacent said discharge surface, said enclosure having an opening for passing the discharge to said anode, said enclosure having a portion opposing outflow of said easily ionizable gas more than said difficult-to-ionize gas.

8. A unidirectional space current discharge device comprising an evacuated envelope containing a gas filling composed of a mixture of different gases, an anode, a cathode having a discharge surface and constituting an enclosure confining a body of said gas filling in said envelope adjacent said discharge surface, said enclosure having an opening for passing the discharge to said anode, said enclosure having portions of different degrees of permeability for the different gases of said mixture.

9. A space current discharge device comprising an evacuated envelope containing a gas, a portion of which is more ionized during the discharge than another portion of it, an anode, and a cathode within said envelope, an enclosure constituting a confinement around a part of the discharge path between said cathode and said anode, and means ad-

jacent to said enclosure to produce movement of gas into said enclosure during a discharge, said enclosure having a portion of different permeability to the gas portion that is more ionized than to the gas portion that is less ionized.

10. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface,
70 whereby a low voltage discharge may be maintained between said cathode surface and said anode.

11. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

Signed by me at Boston, Massachusetts this
71 twenty-sixth day of February 1925.

CHARLES G. SMITH

Oath.

STATE OF MASSACHUSETTS,
County of Suffolk, ss:

Charles G. Smith the above-named petitioner, being sworn, deposes and says that he is a citizen of the United States of America and resident of Medford, Massachusetts that he verily believes himself to be the original, first, and sole inventor of the improvement in

ELECTRIC DEVICE

described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by him or his representatives or assigns in any country foreign to the United States.

CHARLES G. SMITH.

Subscribed and sworn to before me this 26th day of February 1925.

CHAS S GROVER
(Seal) *Notary Public.*

(Here follows photostat marked page 72.)

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Re d U. S. Patent Office

Mail Division
Jun 22 33
U. S. Patent Office

U. S. Patent Office
Paper No. 32
Jun 29 1933
Division 54

To the Commissioner of Patents,
Sir:

Your petitioner, Charles G. Smith, a citizen of the United States, and a resident of Medford, in the County of Middlesex, and Commonwealth of Massachusetts, whose post office address is 75 Terrace Road, Medford, Massachusetts, represents that on March 5, 1925 he filed an application for Letters Patent for an improvement in Electric Devices, Serial No. 13,146, which application was allowed on July 27, 1932, but that he failed to make payment of the final fee within the time allowed by law. He now makes renewed application for Letters Patent for said invention, and prays

250-77.5 E. P.

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The Fig. - 275
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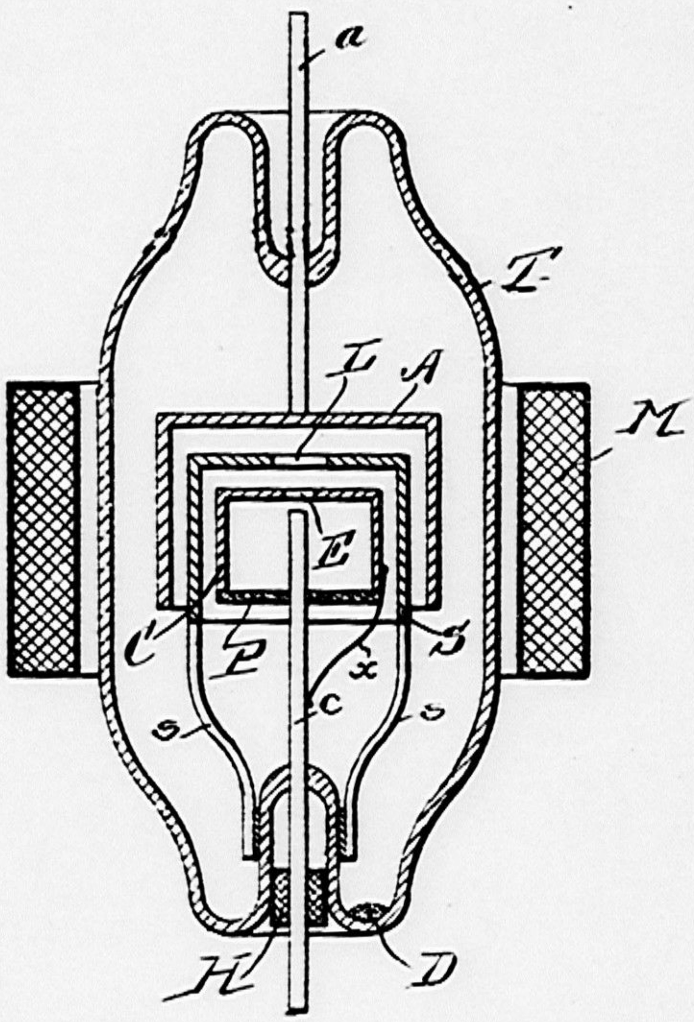

Inventor:
Charles G. Smith,
by Roberts, Roberts & Cushman
Att'ys.

JUL 27 1932

that the original specification, oath and drawing may be used as a part of this application.

Signed at Newton, in the County of Middlesex, and Commonwealth of Massachusetts, this twenty-first day of June, 1933.

CHARLES G. SMITH

By ELMER J. GORN.
Attorney

74 Div. 54 Room 5874 GRD:HVW Paper No. 34

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Please find below a communication from the Examiner in charge of this application.

CONWAY P. COE
Commissioner of Patents.

Applicant: Charles G. Smith
Ser. No. 13,146
Filed June 22, 1933
For Electric Device
Mailed Jul 13 1933

Elmer J. Gorn
55 Chapel Street
Newton, Mass.

Claims 8, 22, 23, 28, 30, 31, 32, 33, and 38 stand allowed.

The newly presented functional or single means claim 40 is rejected as being fully met by the references of record as for instance Rankin.

Claim 41 is rejected as being fully met by the references of record as for instance Rankin or Engler.

No new references being required this rejection is now made Final.

W. E. WAITE.
Examiner.

G.R.D.

75 Appeal No. 10,908 Paper No. 40
Decision.

U. S. Patent Office
Board of Appeals
Appeal No. 10,908 TEM
Jun-2 1934
Mailed

Hearing:
May 10, 1934

In the United States Patent Office

Before the Board of Appeals

Ex parte Charles G. Smith

* * *

Application for Patent filed March 5, 1925, Serial No. 13,146, renewal of application filed June 22, 1933. Electric Device.

Mr. Elmer J. Gorn for applicant.

This is an appeal from the final rejection of claims 40 and 41. Certain claims stand allowed.

The appealed claims are as follows:—

40. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge
adjacent said cathode surface to maintain by cen-
76 trifugal action a high pressure adjacent said cathode
surface, whereby a low voltage discharge may be
maintained between said cathode surface and said anode.

41. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

The reference relied upon by the Examiner is:—

Rankin 838,273 Dec. 11, 1906

The appealed claims relate to an electric discharge device stated to have several aspects of invention. The device comprises a receptacle which may have lower or higher gas pressures or vacuum therein for the purpose of rectifying current or for passing a low potential current in one direction under certain conditions. Various gases may be used therein of different ionizing properties. A mixture of helium and mercury vapor is stated to be the preferred gaseous body but hydrogen may be used instead of helium and caesium, krypton or xenon may be used instead of mercury vapor.

Briefly, in terms of the figure of the drawing, T is the enclosing envelope or tube, a-A constitute an anode, c-C-x constitute a hollow cathode. The member S serves as a kind of shield between the two electrodes except for the opening L. M is a solenoid positioned axially around the assembly.
Passages L and E afford an opening into the interior
77 of the hollow cathode to permit flow of ionized
gas and current from the anode to the cathode. P is a porous member or diaphragm made of sintered quartz or other porous material. It is claimed by applicant that upon applying electric potential between the anode and cathode the gas becomes ionized sufficiently to permit current to flow in unidirectional manner and that the gases within the hollow cathode C are set in physical rotation to create centrifugal force and thereby densify the gas in contact with the inner wall of the cathode C. It is further stated that the diaphragm of the cathode is made of a porous body to permit the escape of helium due to the pressure generated by centrifugal force therein but that the mercury vapor will be retained and will tend to become concentrated therein. In this case the mercury vapor within the cathode would be acted upon by the centrifugal effect.

Claims 40 and 41 have been rejected on two grounds, namely, on the ground that they fail to differentiate from Rankin and on the ground that these claims are functional in form.

An inspection of claim 40 discloses that it includes as definite elements the tube containing a cathode and means for accomplishing certain functions or results, namely, that of rotating the discharge adjacent the cathode to maintain by centrifugal action a high pressure adjacent said cathode surface whereby a low voltage discharge may be maintained between said cathode surface and said anode.

Concerning mere structure it appears that the Examiner's conclusion that these terms read upon the Rankin device is warranted. In the Rankin apparatus b is an anode and c a cathode. Current flows from the anode to the cathode and a solenoid r is positioned around this path of flow of current. Since Rankin's solenoid r is in axial relation to the path of flow of current in the tube we are
78 unable to perceive why the discharge should not rotate in the same way that the discharge between applicant's anode and cathode would rotate so far as the elements of this claim develop. If it be contended that the discharge in Rankin's apparatus would not rotate or whirl, while it does in applicant's device, it must be because of the presence in applicant's device of some of the rather complex detailed structure which is comprised therein. If so this claim fails to include sufficient of such structure. It is our opinion that the terms of claim 40 are anticipated by the elements in Rankin's device. It does not appear from the record that applicant has established that Rankin's mechanism would not produce rotation as contended as well as applicant's device so far as set forth in this claim, since Rankin's device comprises a tube containing a cathode and other "means" broadly such as a solenoid.

It is considered that the second ground of rejection is the main or more important ground of rejection of the claim in that applicant has grouped too much function under one broad term "means". As applicant's drawing clearly illustrates, there is not merely one particular means beside the cathode but several, and it does not appear obvious from mere theory how many of these other elements might be necessary to accomplish all of the results stated in the functional portion of the claim. The claims which have been allowed by the Examiner include the features fairly differentiated and to a sufficient extent to reasonably accomplish the results claimed. It is regarded as clear that this claim falls within the type which has been held not allowable as being functional; *Ex parte* Knudsen 1895 C. D. 29, Bittner 1909 C. D. 32, *Ex parte* Gillman 1925 C. D. 144, *Ex parte*

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10/20/33

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CONTENTS:

Application 2 papers. O K
Permit to Inspect & Copy June 13, 1925
Rej July 28, 1925
Sub. Power Apr. 29, 1926
Amdt A May 1, 1926
Rej. Oct 25, 1926 ~~Letter to Draftsman~~
7. Amendment B OCT 19 1927
8. Rev and Power of Atty by Assignor Dec. 15/27
9. Notices of Revocation and Acceptance Dec. 27/27
10. Rej. May 10, 1928
Amendment C NOV 1 1928
Amendment D FEB 27 1929
13. Rej. MAR 28 1929
14. Change of Address JUN 2 1929
5. Amendment E SEP 10 1929
3. Rej JUL 3 1930
Rev. by applicant July 26, 1930
8. Chief Clerk's Letter Aug. 13, 1930
9. Rev. and Power of Atty by Assignee Sept 5/30
20. Notices of Revocation and Acceptance Sept 19/30
21. Amendment F DEC 13 1930
22. Rej. AUG 5 1931
23. Amendment FEB 4 1932
24. Final Rej! FEB 1 1932
25. Withdrawal and of Power of Attorney by assignee Feb 8 1932

no. 10,908

26. Change of Address APR 25 1932
~~27.~~ Amendment H JUL - 8 1932
28. Exr. Amdt. JUL 27 1932
29. Rev. and Power of Atty by Assignee Nov 21/30
30. Notices of Revocation & Acceptance Dec. 8/32
31. Power to Inspect & make copies JUN - 3 1933
32. Renewal Petition June 22/33
33. Amendment I new rejec. JUN 22 1933
34. Final Rej. JUL 13 1933
35. Authority to inspect & copy Oct 5/33
36. appeal to Board Jan. 10, 1934
37. Exr Statement FEB 2 1934
38. HEARING MAY 10 1934
39. BRIEF MAY 3 1934
40. DECISION BY BOARD JUN 2 1934
41. Notice of Suit under Sec. 4915 RS - Nov 30 - 1934
42. not extd Eq 58006
43.
44. Not up for Action
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GOVERNMENT PRINTING OFFICE

No. 834,998. PATENTED NOV. 6, 1906.

H. J. RYAN.

ELECTRIC WAVE FORM TRACER.

APPLICATION FILED JULY 3, 1905.

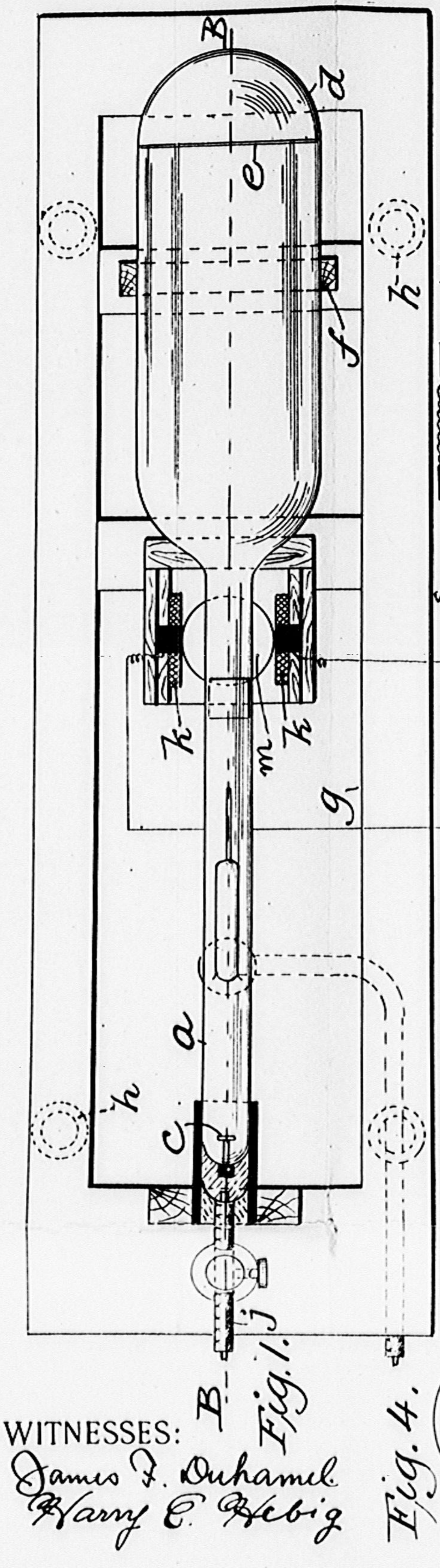


Fig. 1.

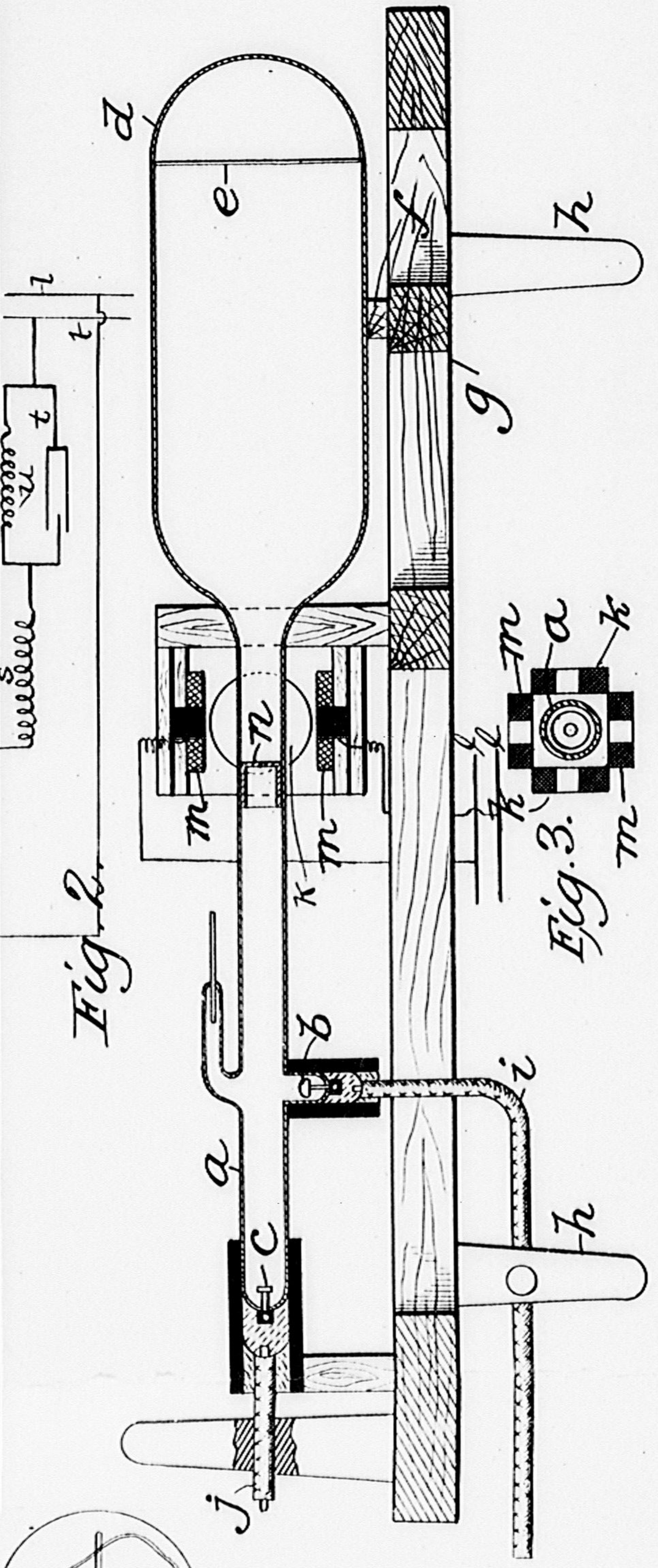


Fig. 2.

Fig. 3.

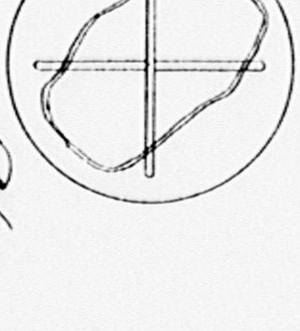


Fig. 4.

WITNESSES:

James F. Duhamel

Harry E. Hebig

INVENTOR:

Harris J. Ryan

By his Attorney

James Hamilton

UNITED STATES PATENT OFFICE.

HARRIS J. RYAN, OF ITHACA, NEW YORK.

ELECTRIC-WAVE-FORM TRACER.

No. 834,998. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed July 3, 1905. Serial No. 268,087.

To all whom it may concern:

Be it known that I, HARRIS J. RYAN, a citizen of the United States, residing in Ithaca, in the county of Tompkins and State of New York, have invented certain new and useful Improvements in Electric-Wave-Form Tracers, of which the following is a description, reference being had to the accompanying drawings.

This invention relates to improvements in devices which visually trace the variations in direction and intensity of an electric current; and the object of my invention is to provide an instrument of this class which shall be simple in construction, accurate in its results, and practical upon a commercial scale.

In the drawings, Figure 1 is a top plan view of my new wave-form tracer. Fig. 2 is a central longitudinal sectional view on line B B of Fig. 1, and Figs. 3 and 4 show details hereinafter referred to.

a is a tube from which the air is exhausted so as to produce a vacuum of high degree and in which are mounted two plates *b* and *c*. This tube is formed at one end with a bulb *d*, in which is mounted a screen *e* and which is held in a U-shaped cradle *f*, mounted upon the base-board *g*, of wood or other suitable material. This base-board *g* rests upon legs *h*, of hard rubber or other suitable insulating material.

Between the screen *e* and the plates *b* and *c* is mounted in the tube *a* the diaphragm *n*, pierced to allow the passage of the pencil of rays generated when the plates *b* and *c* are connected by suitable conductors *i* and *j* with a Holtz machine. Hence the plates *b* and *c* resemble the plates of an ordinary Crookes tube, and hereinafter the plate *b* will be called the "anode" and plate *c* the "cathode."

The pencil of rays has been found to be influenced by a magnetic field, being deflected thereby. The amount of the deflection depends upon the intensity of the field, and the direction of the deflection depends upon the direction of the current producing the field.

k k are two solenoids forming a pair and set on opposite sides of the tube *a*, while *m m* are two other solenoids set on opposite sides of the tube *a* upon a diameter at right angles to the diameter passing through the centers of the solenoids *k k*. (See Fig. 3.) Current is led through the solenoids *m m* from the mains *l l*, which carry the current whose wave-form is to be determined, and current from the same mains is led through suitable reactances and condensers forming a circuit properly arranged to damp out the upper harmonics, and thence through the solenoids *k k*. The object of damping out the upper harmonics is to produce a true sine-wave current through the solenoids *k k*. As shown in the drawings, the arrangement for damping out the upper harmonics of the unknown current, so as to obtain a current of sine-wave form consists of a divided circuit, in one part of which is the inductive resistance *u* and in the other part of which is the condenser *t*, which divided circuit is connected with the solenoids *k k* through the inductive resistance *s*; but current from a source of known wave-form may be led thereto.

The pencil of rays passing through the diaphragm *n* will be deflected by the two currents flowing through the sets of solenoids *m m* and *k k*, so that the spot of light upon the screen *e* will trace a curve which will be the resultant of the curves due to the currents separately. Now since the resultant curve is known and one of its components is known to be a sine curve its other component is readily determined. Persistence of vision enables the operator to trace with a pencil upon a piece of section-paper the curve traced by the rapidly-moving spot of light, or photography may be used to obtain a permanent record of the curve traced. In Fig. 4 I have illustrated one of these curves.

What I claim is—

1. In combination with a vacuum-tube and means for producing a pencil of rays therein, a fixed screen which intercepts said pencil of rays, thereby causing a luminous spot to appear upon said screen; and electromagnetic means for moving said pencil of rays to cause said spot of light to trace a curve upon said screen.

2. In combination with a vacuum-tube and means for generating a beam of light therein, a screen which intercepts said beam a magnetic device energized by the current under examination; and a magnetic device energized by a current whose wave-form is known.

3. In combination with a vacuum-tube and means for generating a pencil of rays therein, a screen which intercepts said pencil, thereby producing a spot of light upon said screen; a suitable source of electricity; an electromagnetic device connected therewith; a second electromagnetic device placed at an angle to the first-named electromag-

netic device; and means for damping out the upper harmonics from a current of varying intensity, said means connecting said source and said second electromagnetic device.

4. In combination with a vacuum-tube and means for generating a pencil of rays therein, a screen which intercepts said pencil of rays, thereby causing a luminous spot to appear upon said screen; and electromagnetic means for causing said spot to trace a curve upon said screen.

5. The combination of a vacuum-tube; means for generating a pencil of rays therein; a screen which intercepts said pencil of rays, thereby causing a luminous spot to appear upon said screen; a suitable source of current; a pair of solenoids connected with said source, one of said solenoids being upon one side of said tube and the other solenoid being upon the opposite side of said tube, said solenoids being connected in series with each other; a second pair of solenoids, one of which is disposed above said tube and the other of which is disposed below said tube; and electrical devices for damping out the upper harmonics of a current of varying intensity, said devices connecting said second pair of solenoids with said source.

HARRIS J. RYAN.

Witnesses:
Dora A. Hildebrant,
Chas. D. Bostwick.

No. 838,273. PATENTED DEC. 11, 1906.

R. RANKIN.

ELECTRIC WAVE FORM TRACER.

APPLICATION FILED AUG. 23, 1905.

Fig. 1.

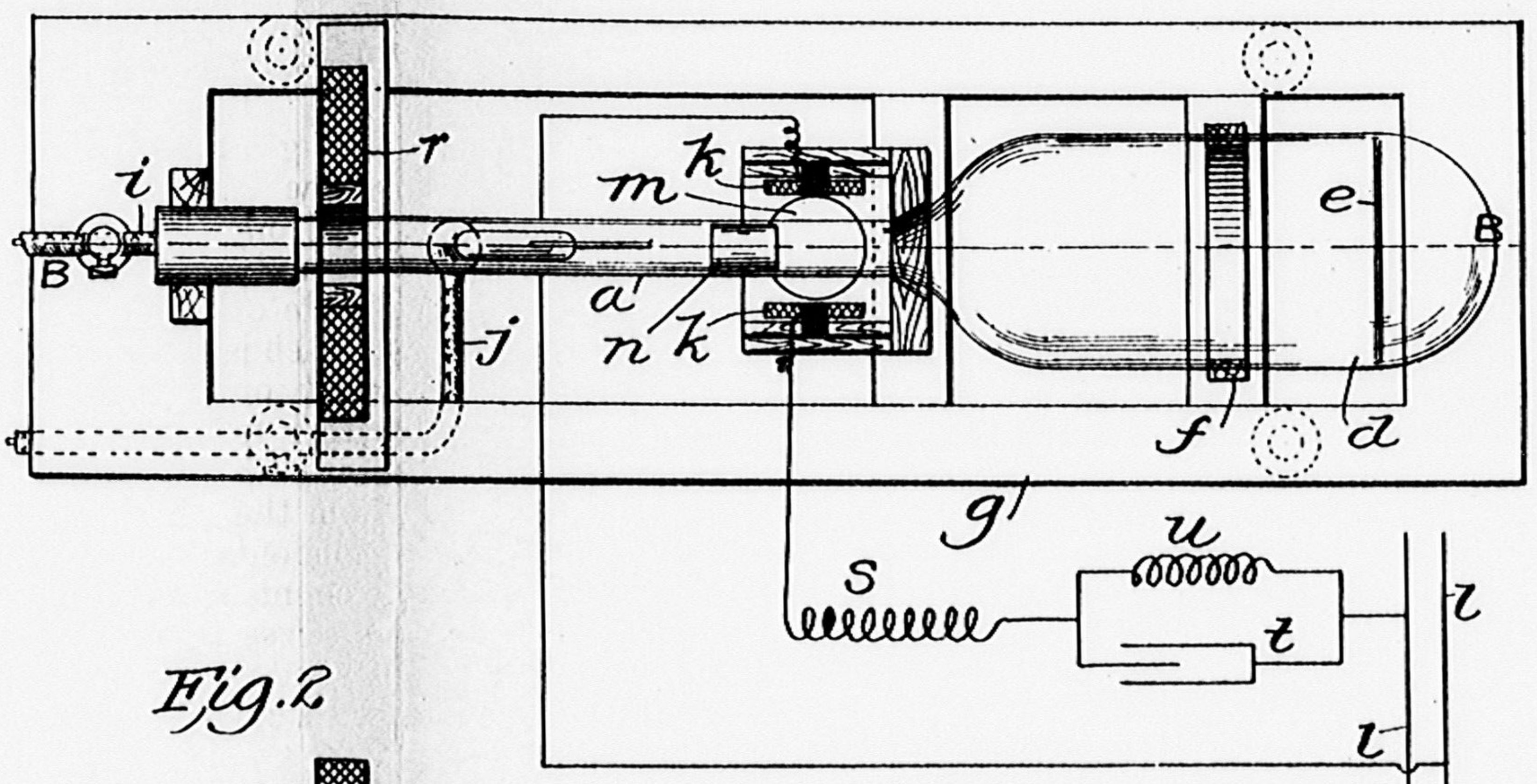


Fig. 2

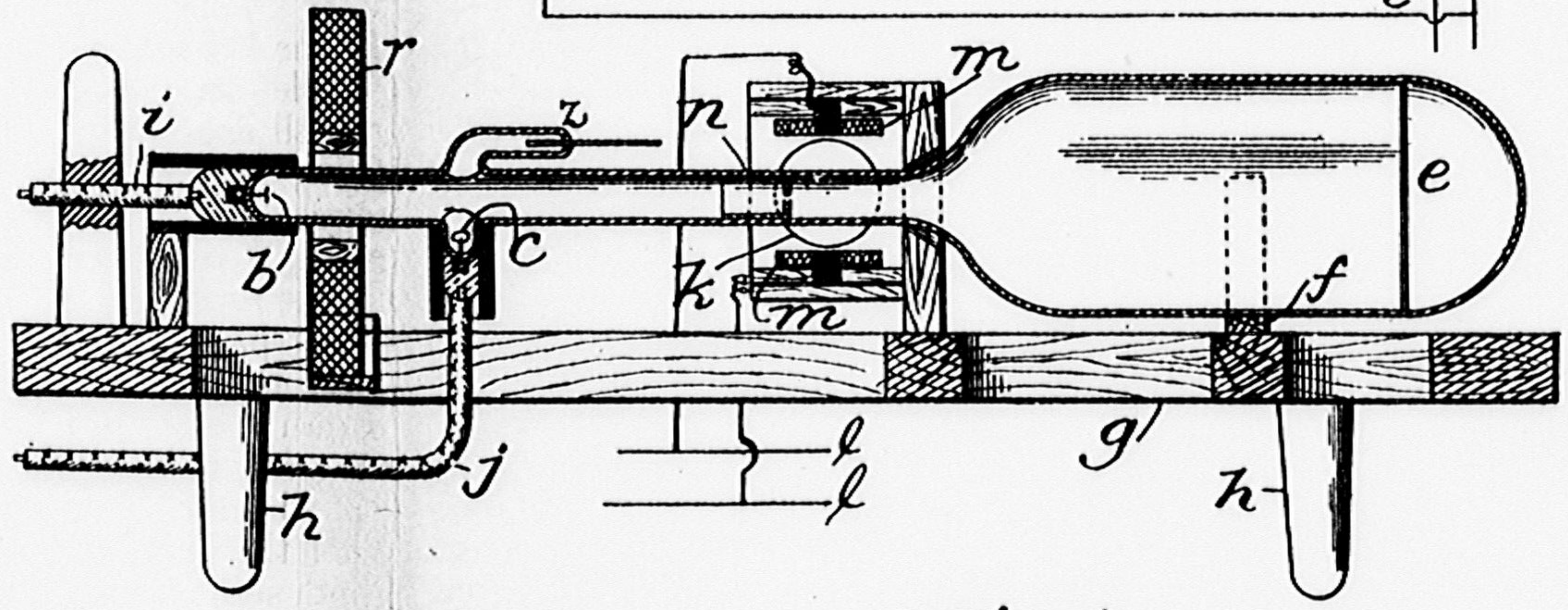


Fig. 3.

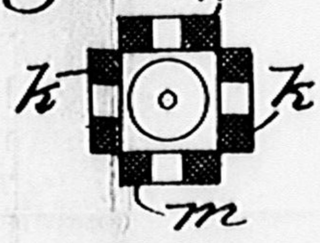
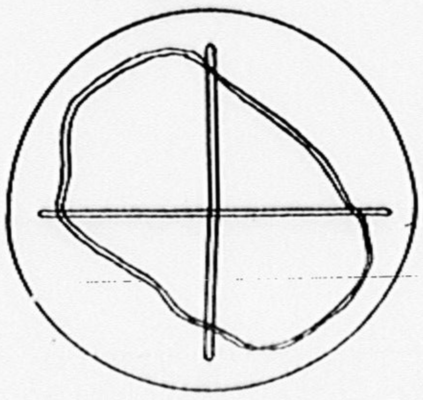


Fig. 4.



WITNESSES:
James F. Duhamel
Harry Hebig.

INVENTOR:
Robert Rankin
By his Attorney
James Hamilton

UNITED STATES PATENT OFFICE.

ROBERT RANKIN, OF ITHACA, NEW YORK.

ELECTRIC-WAVE-FORM TRACER.

No. 838,273. Specification of Letters Patent. Patented Dec. 11, 1906.

Application filed August 23, 1905. Serial No. 275,357.

To all whom it may concern:

Be it known that I, Robert Rankin, a citizen of the United States, residing in Ithaca, in the county of Tompkins and State of New York, have invented certain new and useful Improvements in Electric-Wave-Form Tracers, of which the following is a description, reference being had to the accompanying drawings.

My invention relates to improvements in devices for determining the characteristics of electric waves; and the object of my improvement is to provide a device of the class referred to which shall be simple in construction, accurate in its results, and practical upon a commercial scale.

In the drawings, Figure 1 is a top plan view of my new wave-form tracer. Fig. 2 is a central sectional view on line B B of Fig. 1, and Figs. 3 and 4 show details hereinafter referred to.

a is a tube hermetically sealed the gas-pressure in which is approximately one-tenth of a millimeter of mercury. It is advantageous to use a low gas-pressure, because the pencil of rays generated, as hereinafter described, is not subjected to diffusion by interference with the gas molecules. The tube *a* is formed with a bulb *d* at one end, and this bulb rests in a U-shaped cradle *f*, mounted upon the base-board *g*, of wood or other suitable material. This base-board *g* rests upon legs *h*, of hard rubber or other suitable insulating material.

In the tube *a* are mounted two plates *b* and *c*, which are connected, respectively, by the conductors *i* and *j* with a Wimshurst or Holtz electrostatic machine, (not shown,) and by this connection a current of about five ten-thousandths of an ampere is set up. The plates *b* and *c* resemble the plates of an ordinary Crookes tube, and hereinafter the plate *b* will be called the "anode" and plate *c* the "cathode."

Between the screen *e*, formed of mica and spread with white powder to make it powerfully fluoresce when struck by the cathode-rays, and the cathode *c* is mounted in the tube a diaphragm *n*, opaque to the cathode-rays and pierced by a small central aperture to permit the passage of a pencil of such rays. Upon each side of the tube *a* is mounted a solenoid *k*, the pair of solenoids *k k* being in series, while above and below the tube *a* are mounted two other solenoids *m m*, which likewise form a pair and are in series with each other. The axes of the two pairs or sets of solenoids are at right angles to each other and in the same plane, and the solenoids are mounted just beyond the diaphragm *n*. (See Fig. 3.)

l l are lead-wires carrying alternating current the form of the wave of which is unknown. Current is led through a reactance *s* to a divided circuit, in one branch of which is a condenser *t* and in the other branch of which is a reactance *u*, which is in series with the pair of solenoids *k k*, one terminal of which is connected with a terminal of the condenser *t*, and thence back to the lead-wire. Current is also led from the line directly through the pair of solenoids *m m*. The above-described arrangement of condenser *t* and reactances *s* and *u* serves to throttle or damp out the harmonics and permits to pass through the solenoids *k k* a current having a simple sine-wave form.

The current set up by the Wimshurst machine drives the cathode-rays forward through the tube *a* until all are stopped by the opaque diaphragm *n* except a pencil of rays which passes through its central aperture and causes a bright spot of fluorescent light to appear upon the mica screen *e*.

The current from the line passing through the solenoids *k k* causes vertical motion of the spot of light upon the screen *e*, while the current from the line passing through the solenoids *m m* causes horizontal motion of the same spot of light. When the current from the line flows through both sets of solenoids at the same time, the spot of light moves along a path which is the resultant of the motions due to each set of solenoids separately. Such a path is shown in Fig. 4. Knowing that one of the motions is that due to a current having a sine-wave form, the wave form of the other current, or current through the solenoids *m m*, may be determined.

The above apparatus was invented by Braun and improved by Professor Harris J. Ryan, of Cornell University, Ithaca, New York. One of the chief difficulties in the practical use of this instrument arises from the conductivity of the atmosphere around the terminals of the tube at the high voltages required to establish the pencil of cathode-rays. In this connection the following points are to be noticed: First, the voltage required to establish the pencil of rays increases as the gas-pressure of the tube decreases; second, as before stated, it is advantageous to use a low gas-pressure in the tube in order to prevent diffusion of the pencil of rays; third, the passage of the rays tends to reduce the pressure of the gas, so that after extended use the gas-pressure becomes very low, and the voltage required to establish the pencil of rays must be correspondingly increased, with the result that atmospheric conductivity increases and causes a flickering of the spot of light upon the screen *e*. Heretofore it has been attempted to overcome this evil effect by jacketing the tube *a* between the anode and cathode by means of hard rubber and paraffin; but this jacketing has a corrective effect over only a comparatively short range.

The use of the magnetic coil *r*, placed around the tube *a*, enables the operator to generate the cathode-rays in a tube of very low gas-pressure at a very much lower voltage than that with which it has heretofore been possible to attain the result. Again, the coil *r* produces a remarkable focusing effect upon the cathode-rays, enhancing the brilliancy of the spot of light by forcing more rays through the central aperture in the opaque diaphragm *n*. Hence by the use of the magnetic coil *r* the brilliancy and steadiness of the spot of fluorescent light are greatly increased and the necessity for constant and experienced attention is dispensed with, making the device one capable of industrial and commercial exploitation and use. Furthermore, in case the gas-pressure in the tube *a* rises too high—as, for example, by overheating of the platinum tube *z*—I have found that by the use of a strong magnetic field generated through the coil *r* the gas-pressure will be reduced. Hence a strong magnetic field produced by the coil *r* "restores," so to speak, the vacuum, although this action is effective only when the vacuum is already high enough to start cathode-rays. The strength of field generated by the coil *r* in the ordinary use of the device is not sufficient to affect noticeably the gas-pressure, however.

What I claim is—

1. In combination in a device of the class described, an apparatus for generating cathode-rays, and means for focusing said rays.

2. In combination in a device of the class described, an apparatus for generating cathode-rays; means for changing the normal path of said rays; and means for varying the limit of voltage at which said rays may be generated.

3. In combination in a device of the class described, an apparatus for generating cathode-rays; and means for increasing the brilliancy and steadiness of a pencil of said rays.

4. In combination with a vacuum-tube and means for producing cathode-rays therein, a magnetic coil encircling said tube.

5. In combination with a vacuum-tube and means for producing cathode-rays therein; a diaphragm pierced to permit the passage of a pencil of said rays; a screen placed to intercept said pencil of rays; means for deflecting said pencil of rays to cause a spot to trace a path upon said screen; and means for focusing said pencil of rays to increase the brilliancy of said spot.

6. In combination with a vacuum-tube and means for producing cathode-rays therein; a diaphragm pierced to permit the passage of a pencil of said rays; a screen placed to intercept said pencil of rays; means for deflecting said pencil of rays to cause a spot to trace a path upon said screen; and magnetic means for focusing said pencil of rays to increase the brilliancy of said spot.

7. In the combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and means for controlling the pressure of the gas in said tube.

8. In combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and magnetic means for controlling the pressure of the gas in said tube.

9. In combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and means for reducing the pressure of the gas in said tube.

10. In combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and magnetic means for reducing the pressure of the gas in said tube.

ROBERT RANKIN.

Witnesses:
M. E. Rankin,
M. F. Rankin.

E. REISZ.

RELAY FOR UNDULATORY CURRENTS.

APPLICATION FILED JAN. 30, 1911.

1,059,763. Patented Apr. 22, 1913.

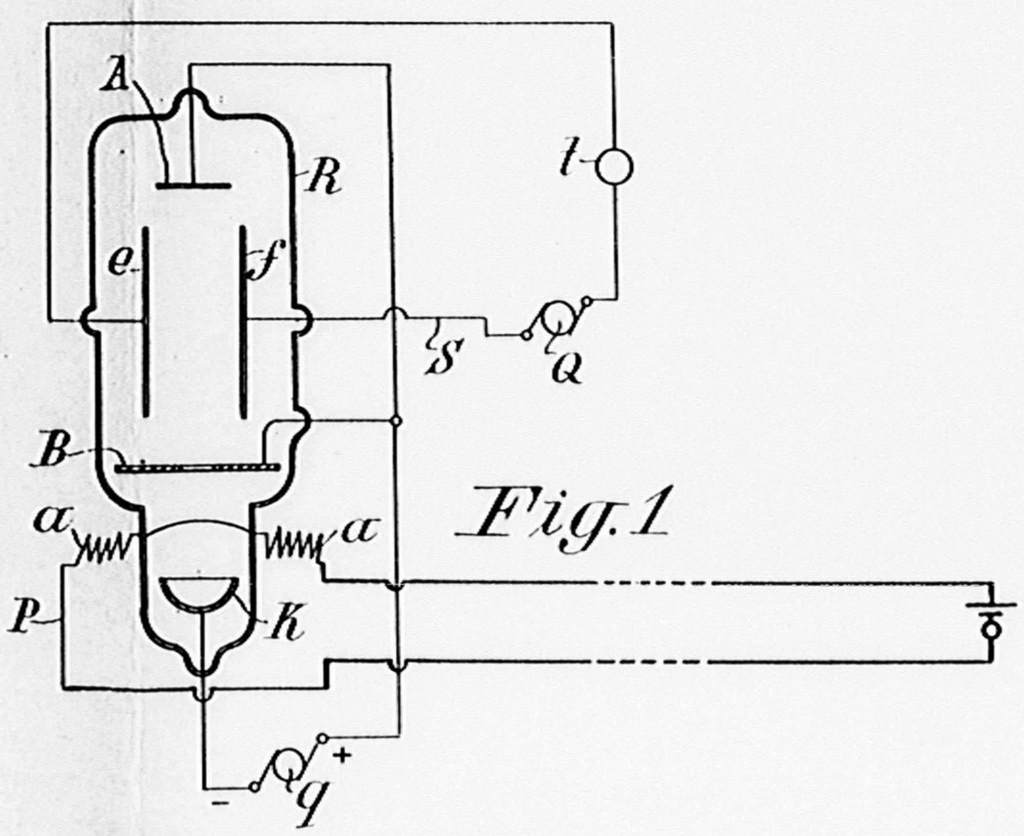


Fig. 1

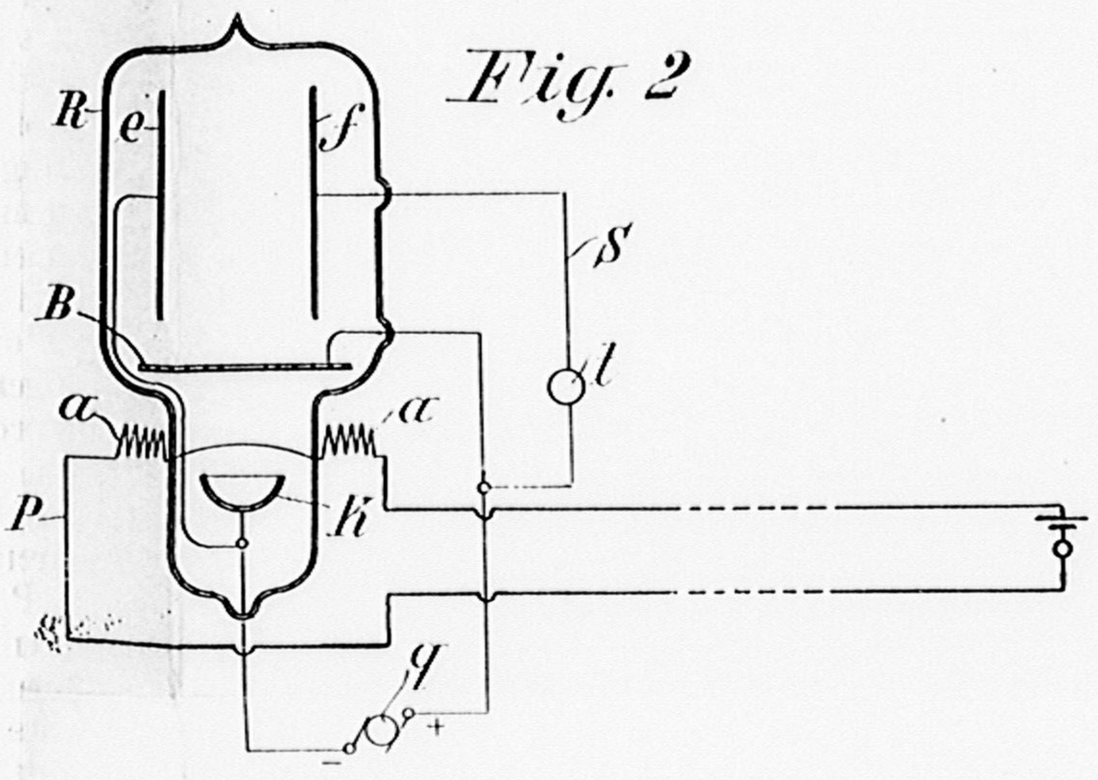


Fig. 2

Witnesses:

Inventor
Eugen Reisz
by
Atty

UNITED STATES PATENT OFFICE.

EUGEN REISZ, OF VIENNA, AUSTRIA-HUNGARY, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE FIRM OF RELAIS-GESELLSCHAFT M. B. H., OF VIENNA, AUSTRIA-HUNGARY.

RELAY FOR UNDULATORY CURRENTS.

1,059,763. Specification of Letters Patent. **Patented Apr. 22, 1913.**

Application filed January 30, 1911. Serial No. 605,547.

To all whom it may concern:

Be it known that I, Eugen Reisz, a subject of the Emperor of Austria-Hungary, residing at Vienna, Austria-Hungary, have invented certain new and useful Improvements in Relays for Undulatory Currents, of which the following is a specification.

This invention relates to relays for undulatory currents of that kind in which an exhausted discharge tube having a cathode and an anode is used, the proportional reproduction of the line currents being obtained by influencing the cathode rays emitted through an electromagnetic or electrostatic action of said line currents.

In the relays heretofore known the reproduction was obtained in the main current passing from the cathode to the anode itself, the passage of said main current being more or less varied by the action on the cathode rays.

It has been found that such relays could only be used within certain limits of current intensity, as the main current, when exceeding a certain value will cause an arclike formation which can no longer be influenced whereby every reproduction is rendered impossible.

The object of the present invention is a relay in which the proportional reproduction can be effected practically at any current strength, without such limits whereby the ratio of reproduction *i. e.* the ratio between the undulating line currents to be reinforced and the main current reproducing the undulations can be greatly increased, which will result in a greater efficiency and a better working as well as in an enlargement of the sphere of application of the relay.

According to this invention the main current does not pass between the cathode and the anode of a discharge tube, but between two plates or other suitable electrodes which are suitably shaped so as to permit no arc formation. It is a well known fact that the passage of current between such electrodes in a discharge tube depends upon the ionization of the gaseous medium in the tube; now this invention provides a suitable ionizer, for example, cathode rays, light, Rontgen rays and the like, which is influenced by the line currents and thereby more or less ionizes or alters the conductivity of the gaseous medium between the electrodes, thus causing corresponding variations in the circuit embodying said electrodes.

It is obvious that the ionizer circuit being external to the circuit of the electrodes, every current strength in the circuit of the electrodes may be used, the said electrodes when suitably shaped preventing an arc formation between them in every case. On the other hand, the ionizer, when embodied itself in the discharge tube, as for example in the case of cathode or Rontgen rays being used as such, may invariably be used with the same current intensity as this latter is quite immaterial with respect to the ratio of reproduction and need only be adjusted with respect to the evacuation of the tube and the distance of the anode.

In the accompanying drawing, the improved relay is shown in two forms; Figure 1 shows an arrangement with a separate source of direct current for the circuit containing the electrodes of the main current and Fig. 2 an arrangement in which the electric generator for producing the cathode rays, which effect the ionization, is also used for the circuit of the electrodes of the secondary or main circuit.

The primary circuit P, in which the variations of electric current to be reinforced occur, contains electromagnet bobbins *a* and is so arranged that these variations of current control the cathode rays produced in a suitably exhausted discharge tube R and acting as an ionizer in the manner hereinafter described.

In the arrangement in Fig. 1 the cathode rays are emitted from a cathode *e. g.* a concave mirror cathode K and the latter together with the corresponding anode A is connected in the circuit of a source *q* of direct current. In the discharge tube R are moreover arranged two flat electrodes *e* and *f* in such a manner that the space between these electrodes lies in the path of the cathode rays. The flat electrodes are arranged in the secondary circuit S containing the source Q of direct current, in which the reinforced variations of current occur and which contains an apparatus t (a telephone, arc lamp, etc.) to be acted upon by such variations of current.

In the path of the cathode rays is arranged a screen or diaphragm B which screens these cathode rays and when it is made of conducting material, is connected with the positive pole of the source q of direct current. If the screen is made of an insulating material an auxiliary anode effects the conduction of the current. The material and temperature of the cathode K (preferably incandescent metallic oxid) and the gas in the discharge tube are preferably so chosen that the emission of cathode rays takes place with even a comparatively low voltage of the source q of current. The rays emitted at such low voltages have a great capacity for being deflected magnetically, whereby increased sensitiveness of the relay is obtained. When the emission of cathode rays has entirely ceased, no current flows in the secondary circuit S between the electrodes e and f since the voltage applied to these electrodes is not sufficient to effect the requisite impact of the ions for producing conduction. If, on the other hand, the cathode rays emitted by the cathode K strike the gaseous space between the electrodes e and f, by reason of the splitting of the gas molecules (ionization) caused thereby, current will flow in the secondary circuit S so long as the ionizer (cathode rays) acts on the gaseous space between e and f.

From the above it follows that, by means of the undulatory currents flowing in the deflecting coils a, *i. e.* by the magnetic deflection of the cathode rays caused by these coils, the conductivity (ionization) of the gaseous space between e and f is altered. This alteration obviously takes place with the same frequency and wave-form as that of the variations of current in the primary circuit P.

In order to enable the maximum intensity of the current to be obtained with the available ionization, the number, size and distance apart of the electrodes are made such that recombining of the split molecules is prevented.

A simplified scheme of connections is shown in Fig. 2, in which the source q of current for emitting the cathode rays is also employed for the secondary electrodes e and f. In this arrangement one electrode e is connected to the cathode conductor, the other electrode being connected to the conductor extending from the source q of electric current to the screen B. It should further be mentioned that the variations of current reinforced by the relay can be caused to act on a second similar relay, whereby a further multiplication of the primary current-waves can be obtained.

The advantage of the arrangement forming the subject of the present invention over the already known cathode-ray relays consists in that, in this relay, the ionizer controlled by the variations of current to be reinforced, releases any desired amount of energy, *i. e.* a current of any desired strength can be caused to pass between the secondary electrodes, in which operation the amount of energy consumed in the ionizer itself can be made comparatively small. This result cannot be attained with the relays heretofore known for the reason that in these relays the cathode rays do not act as an ionizer for a second circuit, but themselves form a constituent part of the circuit for the reinforced current itself, in which arrangement moreover the high vacuum there employed does not permit great intensities of currents or large energies in the form of cathode rays to be employed.

My improved relay for undulatory currents can be used for various purposes, *e. g.* for increasing the strength of sound, as a relay in overhead wire and cable telegraphy for short and long distance working, also in wireless telegraphy and telephony, also as auxiliary apparatus for telegraphones and for the electric transmission of pictures and the like.

Claims.

1. A relay for undulatory currents comprising a discharge tube containing a gaseous medium, an electric circuit embodying electrodes positioned in said medium, means external to said circuit for altering the electric conductivity of the space between the electrodes, and means acting upon the first named means by the variations of the current to be reinforced.

2. A relay for undulatory currents comprising a discharge tube containing a gaseous medium, an electric circuit embodying electrodes positioned in said medium, an ionizer for altering the electric conductivity in the space between the electrodes, said ionizer being external to the circuit of the electrodes and controlled by the undulatory currents to be reinforced to produce a variable ionization in the space between the electrodes.

3. A relay for undulatory currents comprising a discharge tube containing a gaseous medium, an electric circuit embodying electrodes positioned in said medium, an ionizer external to said circuit for ionizing the space between the electrodes, and electromagnetic means for acting upon said ionizer by the variations of the undulatory currents to be reinforced.

4. A relay for undulatory currents comprising an electric circuit embodying electrodes and a cathode whose rays act as an ionizer for ionizing the space between said electrodes, the circuit of said ionizer being independent of the circuit of the electrodes

and controlled by the variations of current to be reinforced, said ionizer effecting an alteration of a gas between the electrodes and producing reinforced variations of current of like frequency and wave form.

5. A relay of the class specified, comprising a suitably exhausted discharge tube, a cathode therein, the rays of the cathode acting as an ionizer, secondary electrodes disposed in the tube and included in an electric circuit, an apertured screen between the cathode and electrodes, the space between the electrodes lying in the path of the cathode rays which are produced by a source of electric current and pass through the screen, and electrical generating means in circuit with the cathode and electrodes.

6. A relay of the class specified, comprising a discharge tube suitably exhausted and having a cathode and secondary electrodes arranged therein, the cathode rays acting as an ionizer and the space between the electrodes lying in the path of the cathode rays, and a source of direct current connected to the cathode and electrodes and serving for the emission of the cathode rays and also simultaneously for supplying the secondary electrodes, the circuit of the cathode being independent of the circuit of the electrodes.

7. A relay for undulatory currents comprising an evacuated tube containing a gaseous medium, an electric circuit embodying electrodes positioned in said medium, a cathode embodied in a circuit independent of the circuit of the electrodes whose rays act as a ionizer operatively associated with said electrodes and controlled by the variations of currents to be reinforced, said ionizer effecting an alteration of the gas between the electrodes and producing reinforced variations of current of like frequency and wave form, and means for deflecting the cathode rays.

8. A relay for undulatory currents comprising an evacuated tube containing a gaseous medium, an electric circuit embodying electrodes positioned in said medium, a cathode embodied in a circuit independent of the circuit of the electrodes whose rays act as an ionizer operatively associated with said electrodes and controlled by the variations of currents to be reinforced, said ionizer effecting an alteration of the gas between the electrodes and producing reinforced variations of current of like frequency and wave form, and electromagnetic means for deflecting the cathode rays.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EUGEN REISZ.

Witnesses:
JOSEF RUBASCH,
AUGUST FUGGER.

K. FISCHER.
ELECTRIC RELAY AND THE LIKE.
APPLICATION FILED AUG. 15, 1913. RENEWED JUNE 10, 1919.

1,328,041. Patented Jan. 13, 1920.

Fig. 1

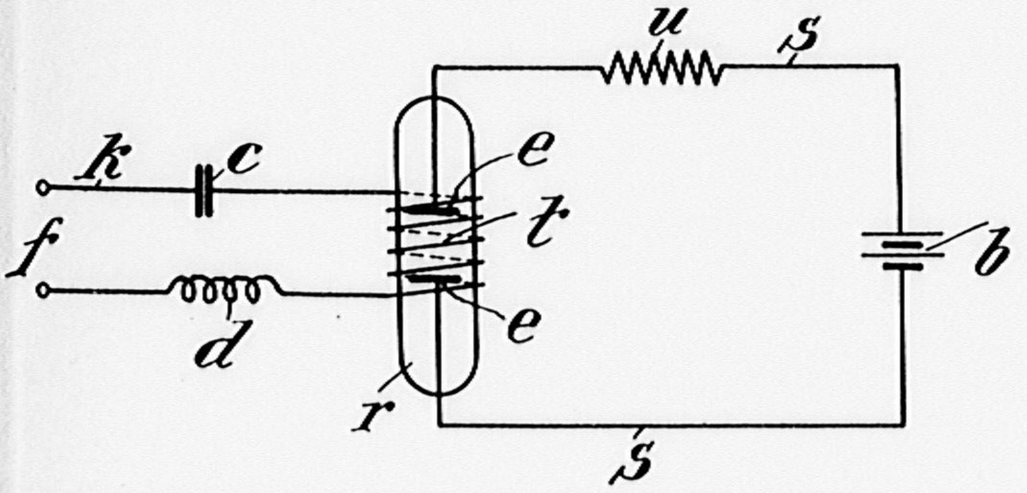


Fig. 2

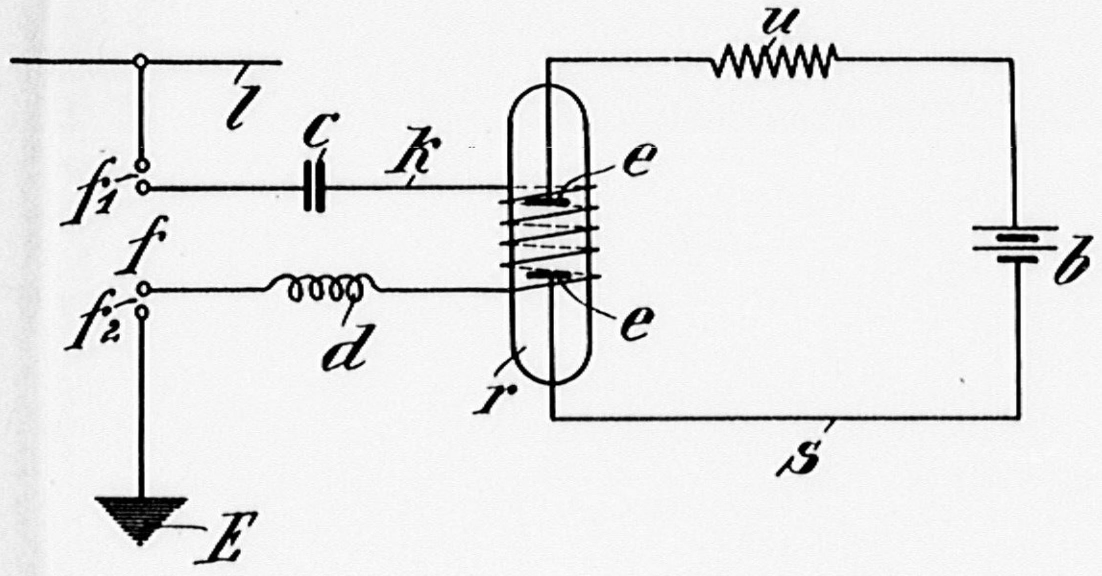
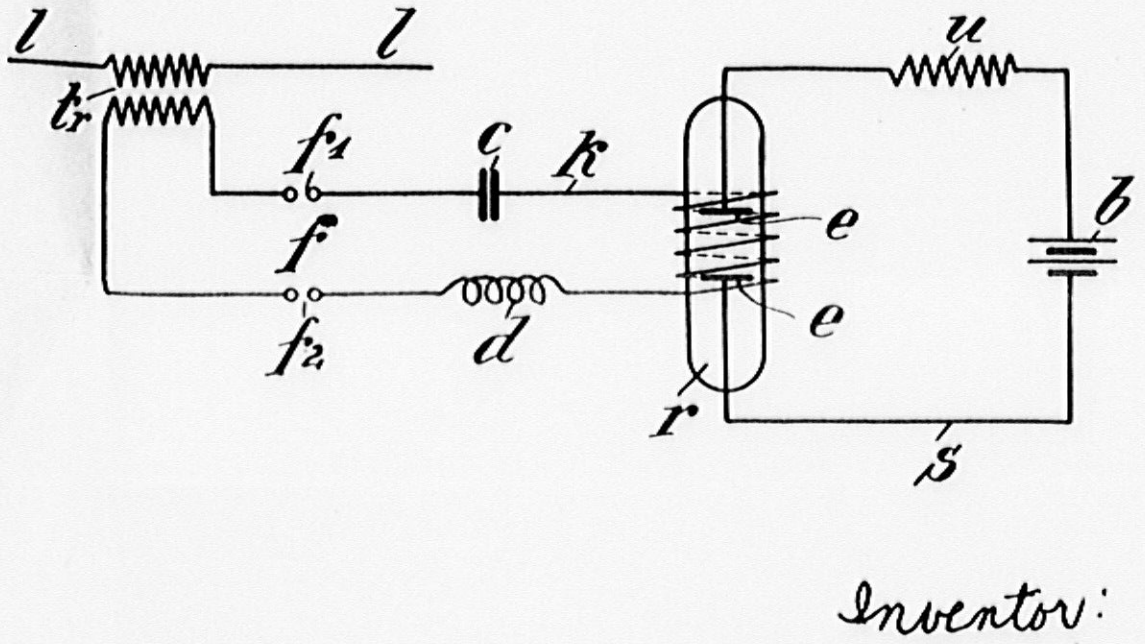


Fig. 3



Witnesses:
Marguerite Schaup
Octavius Knight

Inventor:
Kuno Fischer
by
his Attorney

UNITED STATES PATENT OFFICE.

KUNO FISCHER, OF BERLIN-CHARLOTTENBURG, GERMANY, ASSIGNOR TO SIEMENS-SCHUCKERT WERKE, G. M. B. H., OF BERLIN, GERMANY, A CORPORATION OF GERMANY.

ELECTRIC RELAY AND THE LIKE.

1,328,041. Specification of Letters Patent. **Patented Jan. 13, 1920.**

Application filed August 15, 1913, Serial No. 784,948. Renewed June 10, 1919. Serial No. 303,254.

To all whom it may concern:

Be it known that I, KUNO FISCHER, a German citizen, and resident of Berlin-Charlottenburg, have invented certain new and useful Improvements in Electric Relays and the like, of which the following is a full, clear, and concise specification.

My invention more particularly relates to a class of relays which are actuated by ionizing a gas gap inserted into a control circuit, by reason of which said circuit becomes closed so that controlling or switching devices of all kinds may be operated thereby.

One object of my present invention is to devise an apparatus of this character in which the ionization of the gas is effected in a novel and peculiar manner, viz. by high frequency oscillations which are generated in a special oscillating circuit.

Another object of my invention is to provide a simple and effective protective device for protecting electrical circuits such as transmission lines or cables from electrical disturbances, said device employing the aforementioned relay which is actuated by the ionization of a gas gap through high-frequency currents.

My invention will be more fully understood by reference to the accompanying drawing of which Figure 1 shows the general principle of my present invention to employ high frequency currents for ionizing a gas and rendering the same conductive to close a circuit for the above purpose, Fig. 2 is a modification of the arrangement of Fig. 1 for protecting cables from excessive voltages by causing said excesses of voltage directly to produce a spark through which high frequency oscillations are set up in the high frequency circuit. Fig. 3 shows a modified form of the arrangement illustrated in Fig. 2.

Referring now more particularly to the drawing, in Fig. 1 a tube *r* is shown in which a rarefied gas is inclosed and two terminals are molten into this tube and ending in the electrodes *e* which are positioned within said rarefied gas. Conductors *s* lead from the terminals of said tube to a battery *b*. In a second circuit *k* electrical oscillations are set up by means of a high frequency generating device such as the spark gap *f*, the natural frequency of which may be changed as desired by inserting a capacity *c* and a self-induction *d* into circuit. This high frequency circuit includes a coil or a plurality of turns *t*, said coil or turns being placed around the tube *r*. If the voltage of the circuit with which spark gap *f* is intended to coöperate, exceeds a definite value, the spark gap *f* will operate and high frequency currents are produced in circuit *k* by the oscillatory spark gap discharges, which also pass through coil *t*. Thereby ionization of the gas in the tube is caused which renders the gas conductive. Thus a conductive link is inserted between the electrodes *e* and the circuit *s* will be closed.

The conductivity of the gas gap in its ionized state is very great in case the distance between the electrodes is not too large and in case the electrodes possess a sufficient diameter; it is in fact possible to attain by ionization a conductive path between the electrodes of a resistance which is practically negligible. The arrangement as shown in Fig. 1 may therefore be used in many cases as an efficient and reliable circuit closing device.

In Fig. 2 I have shown the above relay embodied in an arrangement for protecting cables against surges, excessive voltages, as well as excessive currents. With the spark gap *f* which is inserted in the oscillating circuit are associated two further spark gaps f_1 and f_2 connected with conductors of which one is grounded at E and the other connected to the cable *l* which is to be protected. If, now, the voltage of the cable *l* surpass a certain value the relay will come into play in the above described manner and may be used for operating all kinds of signaling devices, safety appliances or cut-out switches as indicated at *u* for the protection of the cable.

The arrangement according to Fig. 3 may be used for protection of the cable *l* against excessive current. In this case the fluctuations of current are transformed by means of a transformer *tr* into voltage fluctuations which if surpassing a certain value will operate the spark gaps in the well known manner.

Having thus described my invention I claim as new and desire to secure by Letters Patent of the United States:—

1. A circuit closing relay comprising a gas tube containing electrodes spaced a suitable distance apart and having corresponding outside terminals, a control circuit con-

nected thereto comprising a source of current and controlling means adapted to be actuated from said current source, said control circuit being normally interrupted by the spacing of said electrodes, and a circuit adapted to produce high frequency oscillations and having a coil surrounding said tube for ionizing the gas therein through said oscillations to close said control circuit at said electrode gap.

2. A circuit closing relay for electric transmission lines comprising a gas tube containing electrodes spaced a suitable distance apart and having corresponding outside terminals, a control circuit connected thereto comprising a source of current and means for controlling said transmission line, adapted to be actuated from said current source, said control circuit being normally interrupted by the spacing of said electrodes, and a circuit having a spark gap, a capacity and an inductance and being operatively connected with said transmission line, said circuit adapted to produce high frequency oscillations at an electric disturbance in said transmission line, said circuit also having a coil surrounding said tube for ionizing the gas therein through said oscillations, to close said control circuit at said electrode gap.

3. A circuit closing relay comprising a gas tube containing electrodes spaced apart, a normally interrupted control circuit including a source of current and outer terminals of said electrodes, and a circuit adapted to produce high frequency oscillations and having a coil surrounding said tube for ionizing the gases therein through said oscillations to close said control circuit across said electrode spacing.

In witness whereof I have hereunto set my signature in the presence of two subscribing witnesses.

KUNO FISCHER.

Witnesses:
Henry Hasper,
Harry L. Wilson.

Felthousen 1924 C. D. 67 and *In re* Gardner 1909 C. D. 306.

Claim 41 requires that the cathode have an extended discharge surface, however, the expression, "extended discharge surface" is indefinite in this relation and it is
79 therefore not clear that the terms of this claim actually avoid Rankin.

Claim 41 is considered subject to the second ground of rejection for the reasons noted in connection with claim 40. Claim 41 as noted in the preceding paragraph includes the requirement that the cathode have an extended surface but yet does not develop that it is a hollow internal surface which is involved and which would apparently be necessary to cause the device to function to produce any high pressure effect. Claim 41 is therefore also held to be deficient in regard to naming sufficient elements of apparatus to accomplish the results or functions alleged and to be subject to the second ground of rejection.

The decision of the Examiner is affirmed.

LESLIE FRAZER
Assistant Commissioner
W. L. REDROW
Examiner-in-Chief
F P EDINBURG
Examiner-in-Chief
Board of Appeals

(Here follows photostat page 80 and pamphlet pages 81 to 94 inclusive.)

97 Div. 54. Rm. 5874 Paper No. 37

Mailed Feb. 6, 1934.

Department of Commerce
United States Patent Office
Washington
Before the Board of Appeals
On Appeal
In re application of Charles G. Smith
Ser. No. 13,146
Filed March 5, 1925
For Electric Device

EXAMINER'S STATEMENT

Applicant appeals from the final rejection of claims 40 and 41; all other claims (8, 22, 23, 28, 30, 31, 32, 33, and 38) stand allowed.

The finally rejected claims are:-

40. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

41. A unidirectional gaseuous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

The reference relied upon is:-

98 Rankin, 838,273, Dec. 11, 1906, 250-27.5-3.1X

The device involved is a gas-filled electric discharge device comprising a tube T containing a cathode C and an anode A for producing an electron discharge during operation of the tube and means in the form of an electro-magnet M for producing a magnetic field in the discharge space between said cathode and said anode. The direction of the lines of force of the magnetic field so produced is in substantial alignment with the direction of the electric discharge between electrodes C and A. It is alleged by applicant that such a combinationn of elements when in operation will impart a centrifugal action to the gas in discharge resulting in producing a high presure in the region adjacent the surface of the cathode. This is said to result in a low voltage discharge between the electrodes.

The functional or single means claim 40 is rejected as being fully met by Rankin, as follows: Rankin discloses a gaseous discharge device comprising a tube *a* containing a cathode *c* and an anode *b* and means comprising a magnetic coil *r* the full equivalent of applicant's magnetic means M for producing a magnetic field in the discharge space between the cathode *c* and anode *b*. As in applicant's tube, the magnetic lines of force in Rankin are in alignment with the path of the discharge between the electrodes. All the

structure called for by claim 40 is disclosed in Rankin. Since the structures are the same it follows that the function is inherent in the structure; Briggs and Jacobi
99 v. Kaisling 311 O.G.; Lovejoy v. Shultz 374 O.G. 704.

No other structure by which the function stated is accomplished is set forth in the claim which covers all possible means for accomplishing a certain function without regard to structure; ex parte Bullock 1907 CD 93; ex parte Kotler 1901 CD 62.

Claim 41 is rejected substantially as claim 40. The cathode C has an extended discharge surface since its surface extends from one side to the other. As all the structure called for by these two rejected claims is found in the reference and since the claimed function is inherent in the disclosure, claims 40 and 41 are disallowed. If claims 40 and 41 read upon applicant's disclosure they read equally well upon the reference; ex parte Cloyes 1924 CD 64.

Claims 40 and 41 appear properly refused allowance.

Respectfully submitted,

B. D.

W. E. WAITE,
Examiner, Division 54.

GRD/hvw
Copy sent Attorney.

105 United States Court of Appeals for the District of Columbia

April Term, 1936

No. 6753

RAYTHEON MANUFACTURING COMPANY and CHARLES G. SMITH, *Appellants*,
vs.
CONWAY P. COE, Commissioner of Patents, *Appellee*

Designation for Printing Record

Now come the appellants in the above-entitled cause, by Delos G. Haynes, their attorney, and direct the clerk to print the record in said cause as filed, except the following parts thereof, which the clerk is directed to omit, namely, pages 23, 44, 81, 92, 93, and 97 to 101, inclusive.

Appellants' counsel will furnish the necessary copies (thirty) of pages 80 and 82-91.

Counsel certifies that the pages designated for omission are immaterial to the determination of the questions involved, and that the printing thereof would be a needless expense.

RAYTHEON MANUFACTURING COMPANY
CHARLES G. SMITH,
Appellants
By DELOS G. HAYNES
Their Attorney

COMMONWEALTH OF MASSACHUSETTS:
County of Middlesex, ss:

George Davis, being duly sworn, deposes and says that on this nineteenth day of June, 1936, he sent by registered mail to Mr. R. F. Whitehead, Patent Office, Washington, D. C., a copy of the Designation for Printing Record.

GEO DAVIS
GEORGE DAVIS

Subscribed and sworn to before me, this 20th day of June, 1936.

HUBERT H. LEWIS
(Seal) *Notary Public*

106 Endorsed on cover: United States Court of Appeals for the District of Columbia. Raytheon Mfg. Co. et al. vs. Conway P. Coe. April Term, 1936. No. 6753. Designation for Printing Record. United States Court of Appeals for the District of Columbia. Filed Jun 22 1936. Moncure Burke, Clerk. Delos G. Haynes, 818 Olive Street, St. Louis, Missouri.

Endorsed on Cover: District of Columbia Supreme Court. No. 6753. Raytheon Manufacturing Company, of Newton, Massachusetts, et al., Appellants, vs. Conway P. Coe, Commissioner of Patents. United States Court of Appeals for the District of Columbia. Filed Jun 17 1936. Moncure Burke, Clerk.

FOR MR. CHIEF JUSTICE MARTIN

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

FILED OCT 21 1936

Moncure Burke
CLERK

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

OCTOBER TERM, 1936.

In Equity No. 6753.

RAYTHEON MANUFACTURING COMPANY and
CHARLES G. SMITH,
Appellants,

v.

CONWAY P. COE, Commissioner of Patents,
Appellee.

BRIEF ON BEHALF OF APPELLANTS.

DELOS G. HAYNES,
Attorney for Appellants.

FREDERICK B. WOLF,
Counsel.

ST. LOUIS LAW PRINTING CO., 415 North Eighth Street. CE ntral 4477.

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United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

OCTOBER TERM, 1936.

In Equity No. 6753.

RAYTHEON MANUFACTURING COMPANY and
CHARLES G. SMITH,
Appellants,

v.

CONWAY P. COE, Commissioner of Patents,
Appellee.

BRIEF ON BEHALF OF APPELLANTS.

STATEMENT OF THE CASE.

This is a patent case coming before this Honorable Court on an appeal from the decision of the Supreme Court of the District of Columbia dismissing a bill in equity that, under Revised Statutes, Section 4915 (35 U. S. C. 63), by an inventor, Charles G. Smith, and his assignee, Raytheon Manufacturing Company, against the Commissioner of Patents, for the issuance of a patent containing, in addition to those claims allowed by the Patent Office, two claims as follows:

> 40. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.
>
> 41. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.

The appellant Smith, on March 5, 1925, filed in the United States Patent Office a patent application, Serial No. 13146, for an improvement in electric device (R. 28). It was duly examined and prosecuted, and on July 27, 1932, was allowed. The application was thereafter forfeited, and renewed (under the statutes controlling the renewal of forfeited patent applications), on June 22, 1933 (R. 50). The renewal application included the two claims above quoted. On July 13, 1933, the two claims above quoted were finally rejected by the Principal Examiner (R. 53). This rejection was affirmed by the Board of Appeals (R. 54-77), whereupon the present suit was brought in the Supreme Court of the District of Columbia under 35 U. S. C. 63.

After trial and argument in the Supreme Court of the District of Columbia the trial justice, in a final decree dated March 10, 1936 (R. 12), dismissed the bill of complaint.

The device described in the patent application at bar relates in general to an electronic discharge device, more particularly, an electronic discharge rectifier of the type containing a cathode and an anode operating in an ionizable gaseous medium in an enclosed envelope or tube. The appellant Smith has found that if the gas pressure or density adjacent the cathode electron-emitting surface is high and the gas pressure or density adjacent the anode surface is low, conditions in the rectifier are as nearly ideal as possible to secure the maximum operation of the rectifier tube. The patent application at bar describes means and arrangements for producing this differential pressure. The device consists of a gas-filled tube T (application drawing, R. 39) having a cathode C and an anode A. The cathode C is arranged so that its inside surface emits electrons, the major portion of said emission coming from the side walls of the cathode adjacent, which the device shown maintains a relatively high pressure or density. The electrons coming from the cathode pass out through the opening E to the anode A. In order to maintain a high pressure or density adjacent the side walls or emitting surfaces of the cathode, Smith conceived of the idea of causing the gas within the hollow cathode C to whirl around at a very rapid rate, and thus maintain by centrifugal action the high pressure adjacent the emitting surface. In order to cause this whirling, a magnet coil M is placed around the cathode C. The lines of force created by the magnet M lie in a direction parallel to the axis of the tube T, each axis lying along the two supporting members *a* and *c*. Since the electrons are emitted from the side walls of the cathode C at right angles to these side walls, the magnetic lines of force are at right angles to the direction of travel of the electrons in the vicinity of the side walls. As is well known, if a stream of electrons passes through a magnetic field at right angles to the direction of the field, a force will be exerted upon the electrons at right angles to both the direction of travel of the electrons and the direction of the magnetic lines of force. The relationship which exists in the tube causes a force to be exerted on the electrons which tends to whirl the electrons and consequently the entire discharge around inside the cathode C, producing centrifugal forces, which cause the gas particles to be thrown to the sides of the cathode, and thus build up a high pressure or density adjacent the side walls. Positive ions which are created in the discharge space are also acted upon in the magnetic field to assist in the whirling action referred to. Therefore, the particular arrangement as described constitutes a rectifier in which conditions are particularly adapted for maximum operation of the device.

The Primary Examiner rejected (R. 53) claim 40 as being a functional or single means claim, and also rejected Claims 40 and 41 upon certain references.

The Board of Appeals of the Patent Office affirmed (R. 54-77) the Examiner, and rejected claims 40 and 41 upon the Rankin patent, No. 838,273. The Board of Appeals also rejected claims 40 and 41 upon a second ground, namely, that these claims were improperly functional.

Upon the filing of the Bill of Complaint against the

Commissioner of Patents in the Court below, the Commissioner of Patents, in his answer thereto, stated (R. 7) that, in addition to the Rankin patent referred to above, the following patents would be presented at the trial:

Fischer—1,328,041—January 13, 1920,
Reisz—1,059,763—April 22, 1913.

The Court below, in a memorandum decision (R. 12), dismissed the Bill of Complaint. However, as set forth (R. 11) in its Findings of Fact, the Court below held that none of the prior art cited discloses

> "means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface,"

as called for by claim 40, or the advantages which arise from such a means. The Findings of Fact of the Court below also show (R. 11-12) that none of the prior art cited discloses

> "means for producing a magnetic field in the discharge space between said cathode surface and said anode to impare a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface,"

as called for by claim 41, or the advantages which said means produce. In its conclusion of law the Court below stated (R. 12) that appellants were not entitled to the allowance of claims 40 and 41 because they differentiated from the prior art only by functional statements.

From the above it will be seen that the issue at bar is whether the portions of claims 40 and 41 quoted above, which are specifically found not to be disclosed in the prior art cited, constitute a sufficient recitation of structure to differentiate patentably from the references cited, or whether they are merely improper statements of function.

In view of the Findings of Fact of the Court below, as discussed above, and the simplicity of the issue involved herein, it is not believed to be necessary to discuss in this brief the actual construction of the prior art patents. If the Court is interested in this point, its attention is respectfully directed to record pages 22 to 27, inclusive.

THE ERRORS RELIED UPON.

The errors in the decree relied upon by appellants are as follows (R. 13):

> 1. In decreeing that the bill of complaint be dismissed, whereas the Court should have granted the prayer of the bill of complaint.
>
> 2. In decreeing that the bill of complaint be dismissed, whereas the Court should have held that the inventions as recited in said claims distinguish effectively and patentably from said prior art.
>
> 3. In concluding (Conclusion of Law No. 1) that the claims differentiate from the prior art only by functional statements.
>
> 4. In not concluding that the claims differentiate from the prior art by recitation of structural differences over the prior art.
>
> 5. In not concluding that the breadth of definition of the structural differences over the prior art is warranted by the breadth of applicant's invention.

CLAIMS 40 AND 41 ARE NOT OBJECTIONABLY FUNCTIONAL.

The object of the invention of the appellant Smith is an increase in the efficiency of his rectifier together with an increased ability of his rectifier to stand high reverse voltages. Smith found that these results could be secured if a high pressure at the cathode and a low pressure at the anode were produced. This differential of pressure might accordingly be termed the effect or result of the Smith invention.

In the case of *In re Gardner,* 32 App. D. C. 249, this Court held claims to be objectionably functional if they recited merely conventional elements together with a single "*means*" plus a statement of function. It is through a misinterpretation of the holding in the decision of this Court in the *Gardner* case, we believe, that the lower tribunals have failed to allow the claims at bar.

The claims at bar are not in fact worded in such a manner as to comprehend a single "*means*" plus a statement of function. Such a wording, applied to the facts of the present invention, we submit, would be about as follows:

> "means for maintaining a high pressure adjacent said cathode surface."

That would be a statement of a single *means* plus a statement of function.

In the two claims at bar, however, the wording is quite different. Claim 40, for example, contains the following limitation:

> "means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface,"

while claim 41 contains the wording:

> "means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface."

It must be realized that in connection with the present invention we are dealing with the arrangement or disposition of gases and electrons, which are highly intangible things. Because of the intangibility of gases and electrons it is quite difficult, at times, to understand what is a gaseous or electronic structure. We maintain that a rotating or moving electronic discharge or gas, in a device such as comprehended within the present invention, is just as truly a structure as is the more tangible armature in an operating motor or generator. Considered in this light, it is at once apparent that there is a great deal more than a "single *means* plus a statement of function" in both claims 40 and 41 at bar.

Remembering that the result or effect to be achieved by the inventor Smith was the establishing of a differential pressure relationship between the anode and cathode, it will readily be seen that in claims 40 and 41 at bar the inventor Smith is not pre-empting the entire field for securing such an effect or result. If he were, then his claims might truly be objected to as improperly functional. On the contrary, Smith in both of the claims at bar has disclosed a *structure* (a moving or rotating gas or electronic discharge) which is his particular structure for procuring his desired effect or result. The appellant Smith in the claims at bar teaches that the desired effect (higher pressure at the cathode) can be obtained if the electronic discharge is rotated adjacent to the cathode, which rotation in turn rotates the body of gas adjacent the cathode, and thus sets up centrifugal forces which build up a higher pressure adjacent the cathode surface. As required by the statutes, appellant Smith discloses a particular arrangement for producing such a rotation of the discharge. The invention is in the moving or rotating discharge as a gas or electronic *structure*, and not in the specific electromagnetic coil whereby such a gas or electronic structure is brought about.

It is notable that in the case at bar the Court below specifically held (Finding of Fact No. 6, R. 11) that the construction specified in claim 40, at bar, includes the novel ("not shown in the prior art"):

> "'means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface,' which means enables a low voltage discharge to be maintained between the cathode surface and the anode, thereby improving the efficiency of the device,"

and, as to claim 41 at bar, the Court below held (Finding of Fact No. 7, R. 11-12) that the claimed structure includes, as novel ("not shown in the prior art"):

> "'means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the re-

> gion adjacent said cathode surface.' This means enables a low voltage discharge to be maintained between the cathode and the anode, whereby the efficiency of the device is improved."

By the above Findings of Fact, the Court below correctly concluded both as to the novelty and the utility of the invention expressed in the claims at bar.

The Court below further held (Finding of Fact No. 8, R. 12) that:

> "The prior art does not show the structure shown in the application in suit; nor rotation of the discharge adjacent the cathode surface to maintain a high pressure adjacent said surface, specified in claim 40; nor a magnetic field imparting gas movement for producing a high pressure in the region adjacent the cathode surface, specified in claim 41."

It is thought that this Court will readily see that in the above-quoted Finding of Fact No. 8 the Court below itself treats the limitations referred to, namely, "rotation of the discharge" and "gas movement" as *structural* features, thereafter setting forth the *function* as "to maintain a high pressure" and "for producing a high pressure," respectively.

In view of the foregoing, we submit that claims 40 and 41 have been erroneously interpreted as objectionably functional, whereas in fact they set forth *structure*, and are patentable in form.

AUTHORITIES HOLDING CLAIMS NOT IMPROPERLY FUNCTIONAL.

Since each case of alleged improper functionality turns upon its own facts, it is substantially impossible to cite any decisions which show that the exact wording of the claims at bar, as interpreted by the invention underlying the wording, is or is not improperly functional. However, as a guide to this Court in understanding what types of claims have either been allowed or sustained as not improperly functional, we cite below certain cases, and the claims that were there involved.

The Supreme Court of the United States, in the case of *Continental v. Eastern*, 210 U. S. 405, sustained the following claim as not improperly functional:

> "In a paper bag machine, the combination of a rotating cylinder provided with one or more pairs of side folding fingers adapted to be moved toward or from each other, a forming plate also provided with side forming fingers adapted to be moved toward or from each other, means for operating said fingers at definite times during the formative action upon the bag tube, operating means for the forming plate adapted to cause the said plate to oscillate about its rear edge upon the surface of the cylinder during the rotary movement of said cylinder, the whole operating for the purpose of opening and forming the bottom of the bag tube, and means to move the bag tube with the cylinder."

In the case of *Morley v. Lancaster*, 129 U. S. 263, the Supreme Court also sustained as valid the following claim:

> "The combination, in a machine for sewing shank-buttons to fabrics, of button-feeding mechanism, appliances for passing a thread through the eye of the button, and locking the loop to the fabric, and feeding mechanism, substantially as set forth."

In the case of *Bake-Rite Mfg. Co. v. Tomlinson*, 16 F. (2d) 556, the Circuit Court of Appeals for the Ninth Circuit held the following claim not invalid as improperly functional:

> "In an apparatus of the character described a receptacle for hot grease; mechanism for turning doughnuts or the like over after they have been in a separate receptacle for a predetermined length of time; a mechanism for thereafter removing them after they have been cooked for a further predetermined length of time."

In the case of *Morgan v. Wellman-Seaver-Morgan*, 18 F. (2d) 395, the Circuit Court of Appeals for the Sixth Circuit held the following claim as valid against a charge that it was improperly functional:

> "In a fuel-feeding mechanism for gas producers, a rotatable charging member having an opening, and supporting means for said member providing a concave seat having a passage to the producer chamber for registration with said opening, and means for segregating a charge of fuel in said member of such a size as to prevent the lodgment of fuel between the edge of said seat and the rear edge of said opening in the rotation of said member."

In the case of *Gilchrist v. Kar-lac,* 29 F. (2d) 153 (certiorari denied, 279 U. S. 838), the Circuit Court of Appeals for the Seventh Circuit held the following claim valid over a charge that it was improperly functional:

> "In a machine of the character described, the combination of a support, an electric motor mounted on said support, an agitator mounted to rotate in a position substantially fixed with respect to the motor, means to automatically retain the receptacle in its co-operative relation with the agitator upon manual manipulation of the receptacle itself into such relation, and means to automatically control the operation of the motor so it will run while the receptacle is held by the retaining means."

In holding the above claim valid and infringed the Court said:

> "Invalidity is urged here on the further ground that the Gilchrist patent is an attempt to monopolize an abstraction. This contention must fail. All of the claims are in terms of structure, and the patent embraces only the device by which the new result is made possible, and lays no claim to the result or function of the combination. That some of the elements of the combination are claimed in terms of 'means' defined in terms of function is not objectionable in combination claims. *Continental Paper Bag Co. v. Eastern Paper Bag Co.,* 210 U. S. 405, 422, 28 S. Ct. 748, 52 L. Ed. 1122."

The above statement of the law by the Circuit Court of Appeals for the Seventh Circuit seems to apply with particular force to the facts in issue in the present case.

In the recent case of *Buono v. Yankee*, 77 F. (2d) 274, the Circuit Court of Appeals for the Second Circuit sustained the following claim as valid against the charge that it was improperly functional:

> "A blind-stitch sewing machine comprising stitch-forming mechanism, a pivoted device adapted to support the material which is being stitched, means for forming a bight in said material while it is located on said pivoted device, a shaft, actuating means actuated by said shaft and automatically tilting said pivoted device at predetermined intervals."

This Court itself, in the case of *Lacroix v. Tyberg*, 33 App. D. C. 586, held the following to be a valid "means" claim:

> "The combination, with a wrapping mechanism, of means for supporting a plurality of bunches, and means for transferring bunches from the supporting means to the wrapping mechanism."

In the case of *In re Spencer*, ~~44~~ 47 F. (2d) 806, the Court of Customs and Patent Appeals, on an *ex parte* appeal, held the following claim to be allowable, over an objection based on its alleged improper functionality:

> "A thermostatic device comprising a flexible bimetallic strip means co-operating with the ends thereof to cause said strip to have the shape of a simple curve at positions of stable equilibrium and to assume the shape of a compound curve at positions of unstable equilibrium."

The foregoing decisions, together with the claims therein quoted, show conclusively that functionality of the type found in the claims here at bar is not improper.

CONCLUSION.

In view of the above it is submitted that appellants' claims at bar are not improperly functional, but, on the contrary, are clearly patentable.

It is therefore respectfully requested that the decision of the lower court be reversed.

Respectfully,

DELOS G. HAYNES,
Attorney for Appellants.

FREDERICK B. WOLF,
Counsel.

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

FILED NOV 12 1936

CLERK

No. 6753

In the United States Court of Appeals for the District of Columbia

RAYTHEON MANUFACTURING COMPANY AND
CHARLES G. SMITH, APPELLANTS

v.

CONWAY P. COE, COMMISSIONER OF PATENTS,
APPELLEE

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF COLUMBIA (NOW DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA)

BRIEF FOR THE COMMISSIONER OF PATENTS

R. F. WHITEHEAD,
Solicitor, United States Patent Office.

In the United States Court of Appeals for the District of Columbia

October Term, 1936

No. 6753

Raytheon Manufacturing Company and
Charles G. Smith, appellants

v.

Conway P. Coe, Commissioner of Patents,
appellee

APPEAL FROM THE SUPREME COURT OF THE DISTRICT OF COLUMBIA (NOW DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA)

BRIEF FOR THE COMMISSIONER OF PATENTS

This is an appeal from the decree of the court below (R. p. 12) dismissing the bill filed by appellant under the provisions of Section 4915 R. S. (35 U. S. C. 63).

By that bill it was sought to have the Commissioner of Patents authorized to issue a patent to plaintiff on the application of its assignor, Charles G. Smith, containing two claims, numbered 40 and

41, in addition to the claims which had been allowed by the Patent Office.

The Smith application was duly allowed with 9 claims; but instead of paying the final fee and taking out his patent, the applicant allowed his application to become forfeited under the provisions of Section 4885 R. S. and subsequently, within the time provided by Section 4897 R. S., renewed the application, presenting therein claims 40 and 41.

The invention relates to an electric device, the object of which was stated in the specification to be as follows (R. p. 41):

> This invention relates to gaseous discharge devices in which ionization is a substantial factor and in which the current density is substantially in excess of that in a glow discharge device. My invention is particularly applicable for use as rectifiers.
>
> Particular objects of the invention are to pass current at a low potential difference between cathode and anode, to avoid excessive heating of the electrodes and associated parts by the cathode-anode current, to produce ample electronic emission from the cathode, to direct the electronic discharge to the anode with minimum resistance, to avoid the necessity of using large quantities of vapor yielding material, to prevent electronic conduction from anode to cathode in response to reverse potential as in rectifying, and in some cases to eliminate the space charge in the region of the anode.

The drawing of the device appears on page 51 of the record.

The Board of Appeals in its decision (R. p. 55) describes the device as follows:

> Briefly, in terms of the figure of the drawing, T is the enclosing envelope or tube, a—A constitute an anode, c—C—x constitute a hollow cathode. The member S serves as a kind of shield between the two electrodes except for the opening L. M is a solenoid positioned axially around the assembly. Passages L and E afford an opening into the interior of the hollow cathode to permit flow of ionized gas and current from the anode to the cathode. P is a porous member or diaphragm made of sintered quartz or other porous material. It is claimed by applicant that upon applying electric potential between the anode and cathode the gas becomes ionized sufficiently to permit current to flow in unidirectional manner and that the gases within the hollow cathode C are set in physical rotation to create centrifugal force and thereby densify the gas in contact with the inner wall of the cathode C. It is further stated that the diaphragm of the cathode is made of a porous body to permit the escape of helium due to the pressure generated by centrifugal force therein but that the mercury vapor will be retained and will tend to become concentrated therein. In this case the mercury vapor within the cathode would be acted upon by the centrifugal effect.

The two claims involved in this appeal read as follows:

> 40. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode.
>
> 41. A unidirectional gaseous discharge device comprising an evacuated envelope containing gas, a cathode having an extended discharge surface producing an electron discharge to said anode during operation, and means for producing a magnetic field in the discharge space between said cathode surface and said anode to impart a gas movement in said envelope for producing a high pressure in the region adjacent said cathode surface, whereby a low voltage discharge, may be maintained between said cathode surface and said anode.

The references which have been relied upon are (R. p. 60 et seq.):

Ryan, 834998, Nov. 6, 1906.
Rankin, 838273, Dec. 11, 1906.
Reisz, 1059753, Apr. 22, 1913.
Fischer, 1328041, Jan. 13, 1920.

The claims in question have been rejected primarily on the ground that they do not define applicant's invention or, in other words, they are broader than any invention disclosed. In particular, these claims were held to be so broad as to differentiate from the prior art only by statements of function.

As showing the difference between the claims which the examiner allowed and claims 40 and 41, which are here involved, one of the allowed claims, original claim 8, as amended, is here reproduced:

> 8. A gaseous discharge device comprising a tube containing gas, an anode and a hollow cathode having a discharge opening in one side thereof, the opening being smaller than the side and located in the central region thereof, and means for rotating the discharge about the axis extending through said opening, thereby to maintain by centrifugal action a pressure inside the cathode higher than outside the cathode.

It is not necessary to describe in detail the structure of the references further than to say that they are in an analogous art. They show evacuated tubes with an arrangement of magnets for effecting the movement of the gas in these tubes.

It will be noted that, other than the statement that the device in question is a gaseous discharge device comprising a tube containing a cathode, there is no statement of any specific structural element, and the next phrase of the claim, which begins "means for rotating said discharge", includes all the other features of the device. The statement following the word "whereby" is merely a statement of the object sought to be obtained.

Claim 41, while somewhat different in its wording, is no more definite as to what applicant disclosed. That claim, like claim 40, seeks to differentiate from the prior art, not by what the device is, but by the result sought to be obtained.

It may be noted at this point that in its brief appellant argues that the moving or rotating gas or electronic discharge is a structural element of the device. It is impossible to see how this gas or electronic discharge can be said to be a structural element of an apparatus in which a certain result is sought to be obtained by the action of a magnet on this gas.

It is submitted that the claims in question are of the type which were condemned by the Supreme Court of the United States so long ago as 1853 in the famous suit of *O'Reilly* v. *Morse,* the decision on which is found in 15 Howward, beginning at page 62. The patent there involved was the famous Morse patent for the electric telegraph, and the claim in question was claim 8, which reads as follows:

> Eighth. I do not propose to limit myself to the specific machinery, or parts of machinery, described in the foregoing specifications and claims; the essence of my invention being the use of the motive power of the electric or galvanic current, which I call electro-magnetism, however developed, for making or printing intelligible characters, letters, or signs, at any distances, being a

> new application of that power, of which I claim to be the first inventor or discoverer.

In that decision the Supreme Court said that the patentee had claimed a patent—

> * * * for an effect produced by the use of electro-magnetism distinct from the process or machinery necessary to produce it. The words of the acts of Congress above quoted show that no patent can lawfully issue upon such a claim.

That whole question was again considered in the equally famous telephone cases, Reports of the Supreme Court of the United States, Vol. 126, which involved the equally famous Bell patent.

The claim of that patent was limited to the use of an undulatory electric current. The Supreme Court distinguished the claims from the claim of the Morse patent and held the claim of the Bell patent valid because it did not claim all ways and all means for transmitting speech electrically, and in its decision (Vol. 126, page 535) said:

> It may be that electricity cannot be used at all for the transmission of speech except in the way Bell has discovered, and that therefore, practically, his patent gives him its exclusive use for that purpose, but that does not make his claim one for the use of electricity distinct from the particular process with which it is connected in his patent. It will, if true, show more clearly the great importance of his discovery, but it will not invalidate his patent.

In other words, the claim having been limited to the use of only one form of electric current, it did not prevent others from using, if they could effectively, other forms of electric current not covered by the claim.

It is submitted that the claims in question distinguish over what the references show only by the use of functional statements and statements of the objects to be accomplished and therefore fall not only within the condemnation of the *O'Reilly* v. *Morse* decision but within the condemnation of many later decisions.

Of the latter, it is deemed sufficient to call attention to two decisions of this Court.

In *In re Gardner,* 32 App. D. C. 249, 1909 C. D. 306, the Court of Appeals of the District of Columbia had before it the same question; that is, the patentability of so-called "functional" claims. In its decision the Court said:

> It is well-settled law that a patent cannot issue for a result sought to be accomplished by the inventor of a machine, but only for the mechanical means or instrumentalities by which that result is to be obtained. One cannot describe a machine which will perform a certain function, and then claim the function itself, and all other machines that may be invented by others to perform the same function.

Then, after referring to Section 4888 R. S. (35 U. S. C. 63), and citing from the case of *O'Reilly* v. *Morse, supra,* said:

> Testing the appealed claims by the rules above stated, we are of the opinion that they were rightly rejected as claims for functions or results. If allowed they would cover means substantially different from those described, which might be discovered by another for accomplishing the same results, namely, the determination of the percentage of entrained liquid in the vapor, as in claim 13, and the indication of heat characteristics and conditions as to dryness, etc., as in the other claims.

In the later decision of *In re Ballman and Evers,* 57 App. D. C. 146, 1927 C. D. 142, the Court had before it, among others, the following claim, which is reproduced in the decision of the Commissioner which was affirmed in *In re Ballman and Evers, supra* (*Ex parte Ballman and Evers,* 1927 C. D. 51):

> 36. A projecting apparatus comprising an object to be projected, a projecting lens, an electric light bulb having part of its surface formed as a reflector and constructed and arranged to receive and concentrate the rays emanating from the filament on said object.

With reference to certain claims, including claim 36, the Commissioner said:

> I am constrained to agree with the Examiners in Chief and the Examiner that claims 36, 37, 41, and 42 are functional in that they do not define sufficient structure. Certainly they do not define any structure

> not found in the references, especially the patent to Welsh, and should not be allowed. It may be they are intended to cover patentable subject matter; but that matter should be defined in concrete terms rather than in mere functional statements.

In its decision the Court, after stating that it was convinced that the conclusion of the Commissioner was correct, said:

> * * * we think it unnecessary to repeat the reasons set out in their opinions in support thereof. We content ourselves therefore with approving and affirming the decision of the Commissioner of Patents herein appealed from.

It is deemed unnecessary to discuss the decisions cited in appellant's brief, since these decisions relate to an entirely different type of claim, namely, claims for the combination of mechanical elements where those elements are defined as means for doing something. That type of claim has been frequently sustained by the courts; for example, by the Supreme Court of the United States in *Morley Sewing Machine Company* v. *Lancaster,* 129 U. S. 263, and this Court in *Lacroix* v. *Tyberg,* 33 App. D. C. 586, 1910 C. D. 263.

It is submitted, therefore, that claims 40 and 41, in the Smith application No. 13,146, were properly refused by the Patent Office, that the bill of complaint in this case was properly dismissed, and that the decree of the lower court should be affirmed, with costs against plaintiff.

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